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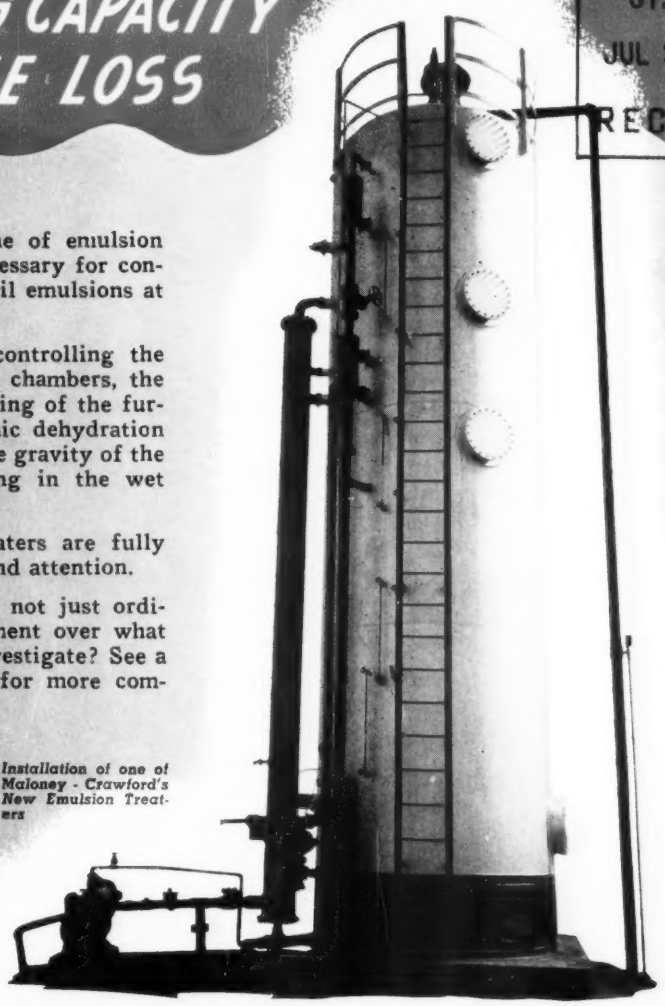

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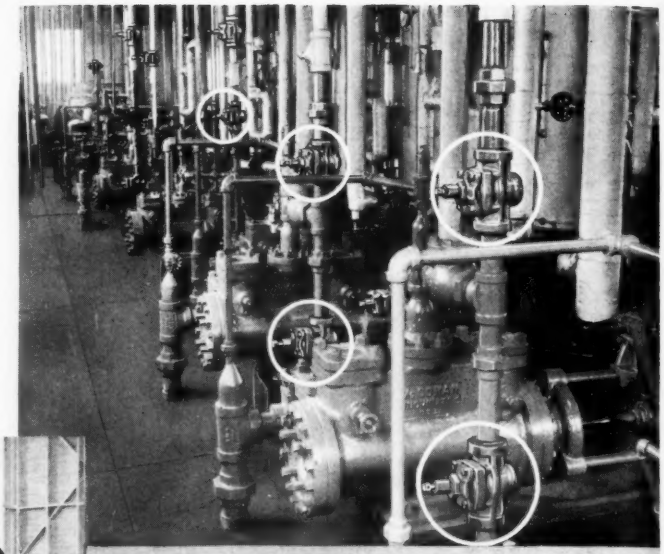

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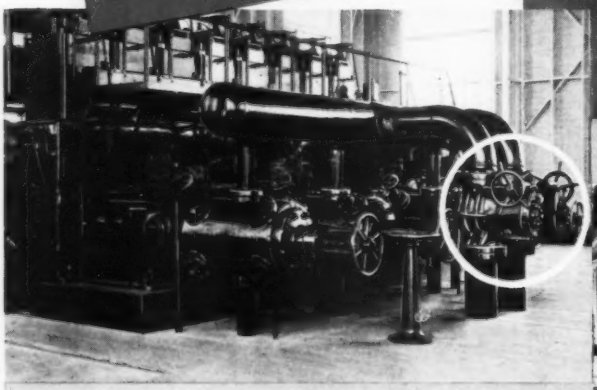
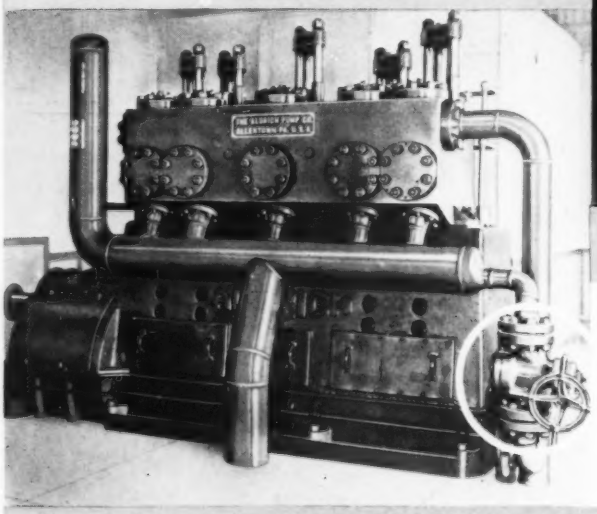
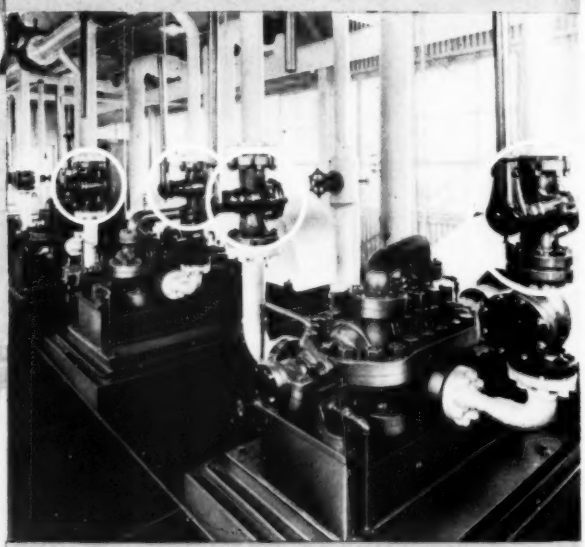


ABOVE: Clark 8-Cylinder, 1600 BHP Gas Engine-Driven Compressor, equipped with Nordstrom Valves.

BELOW: Aldrich Inverted Quintuplex 400 HP 8" Stroke Pump, fitted with Nordstrom Valve used as a by-pass valve for starting against no load.





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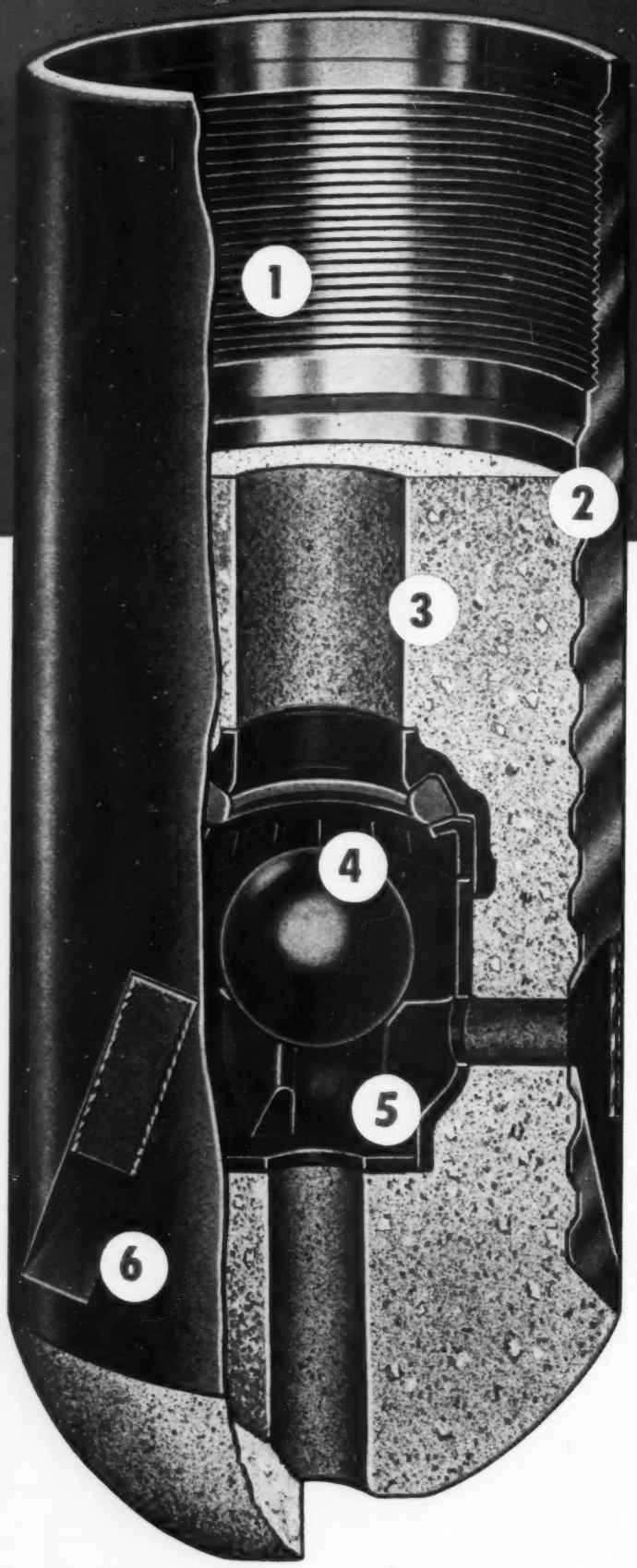

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At Midyear

IN this Midyear Report issue the Journal's editorial staff takes its first look back in the postwar period to see what has happened in the first half of 1946 and, with that background, to project the remainder of the year.

Outstanding is the fact that at no time during the first 6 months did domestic and total world demands decline to the levels generally prophesied for the transition period between the close of the war and the emergence of peacetime markets. Demands were steady during the first quarter and they increased with the start of the main gasoline-consuming season, and by early June the peak levels of a year ago had been passed.

That is where the oil business is today. Instead of a predicted drop of 750,000 to 1,000,000 bbl. daily in total demand as the first anniversary of V-J day approaches, increases have more than offset the decreases in recent months, with no indications that this pattern will change materially soon.

Obviously the petroleum industry as a unit has not had time to adjust all of its operations to these new demands following an emergency period in which there was neither time to plan long-range operating programs nor facilities for effecting them. That needs have been met is another demonstration of the resourcefulness of operators under unexpected conditions.

A study of the reports in this issue will reveal that many things need to be done to assure adequate petroleum supplies. A false sense of security will result from the assumption that because the oil business has met every extraordinary demand in the past it will continue to do so, regardless of operating conditions.

Explorationists found new oil the first 6 months, but the dearth of major discoveries, apparent throughout the war period, continued. Approximately 50 per cent of today's crude-oil output comes from major fields, practically all of which were discovered in the twenties and thirties. This situation proves that finders and producers in this country must have the manpower, equipment, and price incentive to intensify their search for crude oil and also have returns to insure maximum recoveries from existing fields.

In refining, the situation is comparable. Reconversion of war facilities to peacetime schedules has brought general improvement in quality of products. But literally hundreds of millions of dollars will have to be spent over the next few years in modernizing processing equipment of refineries and in the construction of new units in order to preserve these quality standards in an expanding market.

Basic conditions in producing and refining and all the supplementary operations emphasize anew the vital importance of a free market which will assure that in the future as in the past all oil demands will be supplied at reasonable prices.

British Loan Terms Aid World Trade; Oil Equipment Exports to Rise

by Henry D. Ralph

WASHINGTON.—A sizeable expansion in the exports of American oil-industry equipment will be one of the results of the British loan just approved by Congress after months of debate, in the opinion of government foreign trade experts. It will also facilitate the sale of crude oil and products to buyers outside this country.

Some direct benefit to exporters will come from the fact that England now has a credit of $3,750,000,000 which she can draw on during the next 5 years to pay for purchases of American goods and meet other dollar obligations. However, the bulk of this at least immediately, will be used for foodstuffs and necessities, and relatively small amounts are likely to be used for oil equipment.

The greatest benefit will come from the things Great Britain agrees to do in return for the loan. She agrees to abandon or greatly modify the most objectionable features of the "sterling bloc," exchange controls, Empire preference, discriminatory trade agreements, and similar measures taken before and during the war to finance her essential imports and maintain the foreign value of the pound.

These British trade controls, however necessary they may have been to get England through the war, are a severe handicap to all American firms doing business abroad and have worked particular hardships on the foreign operations of American oil companies. The ramifications of these controls are so great that they have had the indirect effect of preventing non-American oil companies operating in countries outside of the "sterling area" from purchasing American oil equipment freely.

The "quid pro quo" Britain gives in exchange for the loan is a series of steps which will not all have immediate effects but which are all in the direction of freeing all international trade, not only British Empire trade, from restrictive barriers in the form of tariffs, licenses, currency manipulations, and exchange controls of various sorts.

Britain and the United States are the two largest foreign trading nations. Moreover, now that Germany and Japan are out of world trade, about two-thirds of the world's trade in the next decade will be done in either dollars or pounds sterling. Until now these two currencies have not been convertible except by special arrangement. Under the British loan agreement the world's two most important currencies are made exchangable with each other at stable rates, and thus the greatest single group of barriers to American exports is removed.

For example, Argentina, though not a member of the "sterling bloc," has built up large sterling balances in London as a result of war sales of meat and other commodities to England. This balance could not be converted into any other currency, and to obtain payment Argentina would have to buy only British goods. Now Argentina will be permitted to convert her sterling balance into dollars and buy American goods if she chooses. It so happens that Argentina also has dollar balances in the United States, and furthermore she may wish to convert her sterling balances into the currencies of some other country, but this illustrates the way in which British exchange controls have operated even outside the British Empire to hamper free international trade and channel export orders to England.

Purchases in Britain Required

Another example of British exchange controls is the situation of American oil companies operating in British Empire areas. Their profits have been in sterling and they have been unable to exchange sterling for dollars in order to repatriate their investments or utilize their profits except by purchasing British goods.

Several extreme illustrations of this situation occurred shortly after the end of the war when American oil companies operating in sterling areas in both the Far East and the Middle East needed to purchase American oil equipment to rehabilitate refineries wrecked by enemy action. These companies had sterling credits but because of the exchange controls they were not allowed to purchase outside the British Empire. However, no British manufacturer could supply the needed equipment, and the U. S. State Department was forced to intervene on several occasions to persuade the British Government to issue the necessary import permits so that these companies could use their own money to buy American equipment to put their properties back in operation. If Britain carries out her end of the loan agreement it will no longer be necessary to get individual licenses for such transactions, and oil operators of any nationality in the sterling area can convert their pounds into dollars for the purchase of American equipment.

The oil industry did not suffer severely from British exchange controls during the war because shipments of both oil and equipment were strictly allocated. Oil was supplied everywhere from sources involving the shortest haul, and facilities were built on the basis of war necessity. However, the exchange control system was beginning to hamper American oil companies abroad before Lend-Lease was started, and since the end of the war it has been a major obstacle to resumption of normal commercial activities.

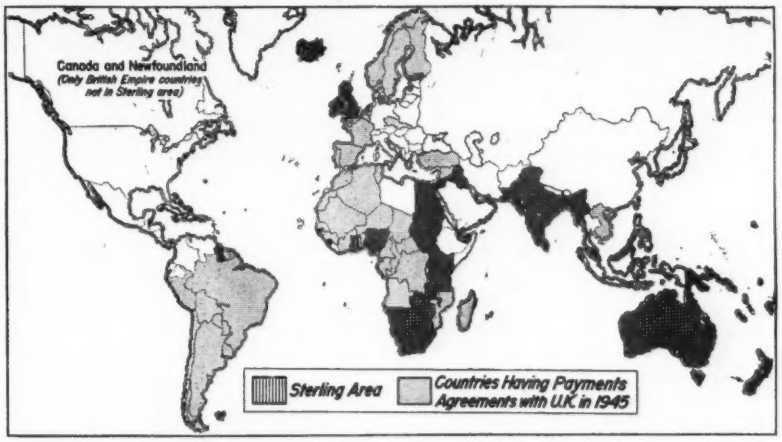
The sterling area encompasses a large volume of trade and produces and consumes a great quantity of oil. In this area importers and exporters of oil are subject to local exchange controls and also to the British dollar pool. Because the British were short of dollars they rationed them and kept imports of dollar oil—and everything else—to the barest minimum. Sterling area markets were supplied by production from within the sterling area, although the normal source of supply might be elsewhere. Where American companies operating in the sterling area sold oil for dollars, these dollars were impounded into the British Empire dollar pool and allocated to some British area for only the most necessary imports which could not be obtained with any other currency. Continuation of this system would put American companies at a disadvantage compared with companies whose home currency is sterling, since the American concerns would accumulate profits in blocked currencies usable only in a particular foreign area.

The exact way in which the British loan agreement will open foreign markets for American oil equipment and other things is a bit difficult to explain because of the technicalities

of foreign exchange and multilateral trade and because of the various devices used by England to protect her financial position during the war.

The "sterling area" proper, which was in existence prior to the war, consists of the British Isles, all Dominions and members of the British commonwealth of nations except Canada and Newfoundland (which are tied to the U. S. dollar), all British colonies, dependencies, protectorates and codominiums, and several independent nations particularly Egypt, Iraq, and Iceland. The currencies of these countries are tied to the British pound and their foreign trade is financed in sterling.

In addition England has sterling payment agreements with a great many other countries, including almost all of South America, the non-British areas of Africa, France and the French colonies, Spain, Portugal, Turkey, and the Scandinavian countries. These nations have agreed to accept sterling for their sales to the sterling area, and this sterling will not be converted into another currency except with the consent of the British Government.


Canada and Newfoundland
(Only British Empire countries not in Sterling area)
Sterling Area
Countries Having Payments Agreements with U.K. in 1945

Protective barriers set up by Great Britain to protect her dollar balances will be lowered as a result of ratification by Congress of the $3,750,000,000 British loan. This map shows the nations associated with the United Kingdom's currency and trade policy. In exchange for the loan, England has agreed, within 1 year, to remove exchange controls on trade with other countries and to dissolve the sterling pool. The oil industry will share in the benefits from the loan through release of blocked credits, sales to Empire countries, particularly of certain types of equipment, and in the general expansion of world trade

Controls Hampered World Trade

In this way the British exchange controls have tied up the foreign trade of a large part of the world outside of the sterling area proper. With so much of the world's trade subject to sterling controls, many nonsterling countries have hesitated to remove their own wartime exchange controls and free their currencies and their foreign trade. Removal of the British restrictions in return for our loan of $3,750,000,000 is counted on to facilitate American exports in many countries outside the sterling area as well as within it.

England's obligations under the loan agreement are as follows:

1. Removal of exchange control on current transactions between England and the United States, effective immediately.

During the war England bought more here than she sold here, so she was short of dollars and placed restrictions on the use of dollars. American exporters who sold to England got paid in pounds which they could not convert to dollars. Now England is removing all exchange controls on day-to-day commercial transactions between the two countries, and any American having British pounds in England can convert them to dollars at a bank without a special license. This does not mean that England will permit unlimited imports of American goods at present, but any imports to England will be paid for in dollars.

2. Within 1 year England will remove exchange controls on trade with other countries. Countries in the sterling area, or which have sterling payment agreements, selling goods in England for pounds cannot change them into dollars or other foreign currencies, so were forced to buy British goods if they wanted to get paid.

3. Within 1 year England will dissolve the sterling pool. During the war all the dollars that were earned by any part of the British Empire were pooled in London and rationed, so that an Empire country selling goods to the United States could not use its dollars to buy American products. Continuation of this pool could effectively shut American manufacturers out of the entire sterling area.

4. England agrees to settle her external debt. At present both Empire and non-British countries which loaned money to England or sold goods during the war have sterling credits which can't be converted into dollars and are good for nothing except to buy British goods.

5. The British import-quota system will be modified so that by the end of 1946 it will not operate to discriminate against American goods. Like most nations at war England permitted imports only on license, and the system has been continued as a means of protecting the value of the pound. However, this system, whether deliberately or accidentally, has been administered in such a way as to discriminate against American traders. England does not have to abolish her import-quota system at once, but must stop its discriminatory aspects.

6. The imperial-preference system will be reduced or eliminated over a period of years. During the depression of the thirties, British Empire countries raised their tariffs but gave preferential duty rates to Empire goods, thus handicapping American exporters.

7. England agrees to support the United States program for worldwide reduction of tariffs and the other trade barriers. This is a long-range, far-reaching program, formally announced by our State Department last December, calling for a series of steps through reciprocal trade agreements, the United Nations Economic and Social Council, and other means, looking toward greater freedom of international trade.

Our Government's foreign trade experts say that unless England had agreed to do these things in exchange for our loan the British would have had no alternative but to tighten the "sterling bloc" and force exports of British goods.

The agreement making pounds and dollars interchangeable, they say, is the key to improved world trade everywhere, as well as being an immediate advantage to American exporters.

Oil-industry equipment, before the war, was manufactured chiefly by the United States, England, and Germany, but American equipment was universally preferred where there was a free choice and where tariffs and exchange controls made it available. Continuation of the sterling exchange controls might have resulted in England building up a large business in manufacturing oil-industry equipment for export to the sterling area and also to non-British countries with sterling balances.

England's commitments now promise to open up all foreign markets for American oil equipment and also to permit the international trade in petroleum to move more freely and to facilitate the commercial transactions of American oil companies operating within the sterling area.

West Texas, Gulf Area Take Cut In August Crude Allowable

AUSTIN.—While Texas' demand for crude oil continues strong, completion of Navy contracts for some 40,000 bbl. daily from the West Texas Permian Basin, the ending of tank-car subsidies July 31 on movements out of Midland, and the increase in above-ground stocks, principally in West Texas, influenced the Texas Railroad Commission in reducing the August allowable to 2,164,526 bbl. daily at the state-wide hearing held last week.

The August reduction of 98,829 bbl. daily will effect West Texas and the Gulf Coast. West Texas allowables were set at 558,760 bbl. daily in August, a decrease of 52,505 bbl. under July. Gulf Coast fields were cut to 526,708 bbl. daily in August—25,448 bbl. under July. West Texas reduction was effected by cutting the district's producing days to 24 in August, 3 less than in July. The remainder of the state was assigned 26 producing days, 1 less than in July, with the exception of East Texas, which remains at 21 producing days, and the Panhandle which is exempt from shutdown days.

Refineries on the Gulf Coast again reported crude shortages and had asked that no reduction be made in present allowable. Sinclair Prairie Oil Co. reported it lacked enough Texas oil to fill its requirements, as did four independent refineries in the Houston area. Two fields in the Gulf Coast area, Anahuac and Sugar Land, were given reductions in August after a revision downward in maximum efficiency rates. Anahuac was assigned an allowable of 34,440 bbl. daily in August, and Sugar Land 5,740 bbl. daily. Smith Point field was given an allowable of 3,788 bbl. daily in August under an upwardly revised maximum efficiency rate.

West Texas operators, including representatives from Humble Oil & Refining Co., Shell Oil Co., Inc., and Ohio Oil Co., had appealed to the oil regulatory body to reduce their allowables to prevent excessive crude in above-ground storage. Operators said that reduction was necessary principally because Navy contracts were being completed and with federal subsidy on tank car shipments ending July 31, tank car movements from Midland would end. They asked for a cutback to slightly more than pipe line capacity from the pools, since the overage was said to be needed by local refineries.

Under the August order, the average daily allowable will be 2,308,628 bbl., but estimated underproduction of some 6 per cent should reduce the flow of crude to 2,164,526 bbl. daily, which is 44,526 bbl. above the Bureau of Mines August estimate of demand in Texas.

In Carthage gas field, Panola County, some producers and royalty owners registered complaint with the commission that gas companies are not purchasing equally from wells in the field. An attorney estimated 100 wells in the field are without marketing outlets. A proration order setting allowable in the field, suspended for the past 6 months, will be reinstated August 1.

Northeast Oklahoma Group To Promote Water Flooding

BARTLESVILLE, Okla. — A new organization consisting of stripper well operators in the area near Bartlesville was formed here last week for the purpose of promoting secondary recovery by water flooding.

The group held its initial meeting at the invitation of Russell Straight, independent operator. C. D. Earlougher, Earlougher Engineering, Inc., Tulsa, reviewed the steps necessary in a successful water-flooding program. He was assisted by William Heath, Phillips Petroleum Co., and several other engineers.

Answers in "Mother Hubbard" Case Indicate Finish Fight in Court

WASHINGTON. — A disposition to fight to the last ditch was evident in the answers and motions filed with the U. S. District Court here Monday and the Government's antitrust suit against the American Petroleum Institute and 21 major oil companies and their subsidiaries.

None of the more than 200 defendants admitted any of the charges in the 6-year-old complaint nor hinted that they might negotiate for a consent decree. Instead they filed denials, motions to dismiss, and long series of technical motions attacking the court's jurisdiction, objecting to the form of certain of the charges, and asking for bills of particulars or interrogatories from the Department of Justice.

Some of the defendants, including the A.P.I., Sun Oil, Standard of California, and Standard of Indiana, filed separate answers, while others combined in groups, including one group of 153 defendants and another of 15. These group answers contained the statement that the defendants were using a single set of motion papers for the convenience of the court but each defendant reserved the right to be heard individually through its own counsel. This means that while the companies are maintaining a more or less united front in their defense plans the Government may have to proceed with the trial as though it had a separate case against each one of the defendants.

Although worded somewhat differently, the motions in each answer follow a common pattern. Except for those companies actually doing business in the District of Columbia, they deny the venue of the court and ask for dismissal for lack of jurisdiction. They also deny that the court has jurisdiction over alleged violations of the Interstate Commerce Act, Elkins Pipe-Line Act, and Robinson-Patman wholesale discount.

Severance of the individual defendants from the "Mother Hubbard" complaint and either dismissal or filing of separate suits is asked by all the companies.

The chief feature of all the answers is a motion that the court require the Government to submit a bill of particulars or answer a long series of interrogatories giving details of the many charges stated in general terms in the original suit.

In addition there are a number of motions, some filed by the Department of Justice, asking dismissal as to various defendants which have lost their corporate identify through dissolution or merger. Because of the large number of motions and their technical nature it is doubtful that the court will take important action immediately.

Ethyl Gasoline Corp. was dismissed as a defendant on motion of the Department of Justice with the explanation that since the original complaint was filed Ethyl has changed its distribution and licensing system so as to avoid violating antitrust law and as a result the charges in the complaint do not apply. However, this does not necessarily mean that the department will drop charges that other defendants attempted to conspire with Ethyl to prevent the use of tetraethyl lead by gasoline-price cutters.

THIS 1946 WEEK

S M T W T F S

INTERNATIONAL—Marked expansion in exports of U. S. oil-industry equipment due to follow ratification of British loan. . . . Agreement provides lifting exchange restrictions on American companies operating in sterling areas. . . . Funds advanced will enable Britain to buy U. S. petroleum items more freely. . . . ¶Anglo-Iranian production resumed with end of 3-day strike. . . . British officials term walkout "purely political." . . . ¶Creole's production reaches new high in June with 570,040-bbl. daily average.

PRICES—Oil industry again assured of continued freedom from price controls under terms of new OPA revival bill drafted in House-Senate conference committee. . . . Measure retains Moore amendment providing decontrol unless new board finds price has gone up unduly or supply fails to equal demand. . . . Quick passage and Truman's approval forecast. . . . ¶Daily gasoline demand estimated 100,000 bbl. greater in week ended July 13. . . . Total placed at 2,239,000 bbl. daily. . . . ¶Prices hold at ceiling levels reached before OPA expired. . . . Lube oils and gasoline extremely tight. . . .

LEGISLATION—Senate passes resolution quitclaiming tidelands to states. . . . Majority Leader Barkley asserts bill will be vetoed. . . . Single Senate amendment declares U. S. claim to continental shelf beyond 3-mile limit. . . .

LITIGATION—A.P.I. and oil-industry defendants in Government's "Mother Hubbard" antitrust case file voluminous motions and denials in U. S. District Court in Washington. . . . Action indicates slim chance of compromise settlement. . . . Defendants ask Government make its charges more specific. . . . J. Howard Pew, Sun Oil president, says Sun's interrogatories in the case are an "effort to focus the vague, broadside allegation into specific charges of alleged unlawful acts." . . .

PRODUCTION—Texas Railroad Commission reduces allowable for August 98,829 bbl. daily. . . . Cut centered in West Texas and Gulf areas. . . . Estimated Texas production under order placed at 2,164,526 bbl. daily. . . . ¶U. S. production in week ended July 20 increases 14,030 bbl. to 4,947,790 bbl. daily. . . . California responsible for most of gain. . . . ¶Crude stocks rise to 222,859,000 bbl. July 13—482,000 bbl. over previous week. . . . ¶Well completions in week ended July 20 reported at 576, against 536 in previous week. . . .

TRANSPORTATION—WAA discloses receipt of seven offers to buy and three to lease big-inch lines. . . . More are expected before bids are opened July 31. . . . Most offers thus far contemplate use of lines as oil carriers. . . . ¶Maritime Commission works to untangle regulations before beginning sale of surplus U. S. ships. . . . Fifty-six applications received for tankers. . . . ¶Indiana Standard confirms report it is planning new 662-mile 8-in. and 10-in. products line from Whiting to Minneapolis and Moorehead, Minn. . . . Work to start in next few weeks. . . .

NATURAL GAS—Federal Power Commission hearing in Washington enters final 2 weeks. . . . Gas-industry committee presents case against further restrictive regulation. . . . DeGolyer gives commission new estimate of reserves, placing total for nation at 144,289,552,000,000 cu. ft. . . .

Scenes such as these are becoming common throughout the country as a result of the tremendous postwar expansion of the oil industry's pipe-line facilities. Among them is Humble's new 276-mile, 8-in. products line extending from the Baytown refinery to the Dallas-Fort Worth area. Pictured here is the laying of the line a few miles south of Dallas where it curves down into Waxahachie Creek. When it begins operating about September 15, the new carrier will be able to deliver about 15,000 bbl. of gasoline and other products to the North Texas area

FPC Hears Gas Industry's Case Against Further Regulation

WASHINGTON.—Reasons why natural gas should not be subjected to more restrictive government regulation than other fuels are being argued in detail these final 2 weeks of the Federal Power Commission's lengthy investigation of the natural-gas industry.

A series of elaborate presentations prepared by the Natural Gas Industry Committee began last week and will continue until the hearings end, furnishing the commission with voluminous data on the status and future of the industry, its relationship with other energy resources, and the proper scope of government regulation. For weeks the commission has been hearing spokesmen for railroad and coal interests urge strict regulation of natural gas to conserve it for future generations and to prevent it from competing with older fuels.

The industry's case includes showings that natural gas reserves are plentiful and increasing; that gas service is dependable, economical, and preferred by consumers; that gas appears to be a threat to coal largely because the coal industry is backward in its research and service to consumers and because coal deliveries are so frequently interrupted by strikes; that natural gas is not irreplaceable because it can be manufactured from coal at a low cost by methods now being perfected; and that within a few years atomic energy may replace both coal and gas for many heat and power uses.

Buddrus, Hargrove Testify

Personal observations on administration of the natural-gas act were presented to the commission Monday by E. Buddrus, Chicago, president of Panhandle Eastern Pipe Line Co., and R. H. Hargrove, Shreveport, vice president of United Gas Pipe Line Co., though both explained they were appearing as individuals rather than as members of the natural gas industry committee.

Buddrus' chief point was that FPC should take a long-range view of the gas industry and of the public interest, declaring that the commission has been too much concerned with regulatory details, the objections of coal and railroad interests, and short-range day-to-day problems. He said that restrictions on pipe-line earnings, limitations on certificates for new pipe-line construction, and threats to regulate end use, service areas, and industrial rates are having the effect of discouraging conservation and the search for additional reserves.

Hargrove discussed administrative problems of the natural-gas act from the standpoint of an operating company official, saying that the commission's authority and responsibility is so great that it should make sure its orders are just, fair, and reasonable as well as legal. He urged FPC to be concerned with the health of the gas industry and the interests of supplies, labor, capital, and markets instead of looking only at consumers' rates.

The lead-off witness for the gas industry was E. Holley Poe, former official of the Petroleum Administration for War and now head of a consulting firm, who presented a paper on the dependability of the natural-gas industry in the public service and who devoted a good deal of his time to criticizing the Power Commission for paying so much attention to the coal industry's constant efforts to block growth of natural-gas service.

The two industries should be allowed to compete on an equal basis, Poe said, and the natural-gas act does not give FPC any powers to erect artificial barriers to protect any other industry nor to subject natural gas to any restrictions on distribution or utilization not common to other public utility regulation.

Delays in extending natural-gas service to more sections of the country are attributed largely to the FPC's rules permitting practically unlimited interventions by the coal and railroad industries at hearings on proposed new-service facilities, Poe said.

"FPC's administration of the Natural Gas Act often has given the impression of considered solicitude for the coal and railroad interests, with which it has no administrative relationships," he continued. "FPC often has given the impression that it felt called upon to act in the unappointed capacity of umpire in the industrial competition between the coal and gas industries."

The natural-gas industry does not fear the competition of the coal industry, Poe said, but it does fear the possibility of the application of sociological criteria in FPC's administration of the Natural Gas Act.

The coal-railroad-labor groups filed 1,570 interventions that were related to 63 applications to FPC for required certificates in proposed natural-gas service expansions since 1942, according to an exhibit prepared by Samuel H. Crosby, an earlier witness and a member of Poe's staff.

"I do not believe that Congress ever intended some of the results which have developed in the past administration of the act," Poe declared. "Electricity, coal, natural gas, petroleum, water power, and any other source of energy cannot claim priority in any market, in view of the pace that is being maintained by new discoveries, their development and utilization."

Gas Industry Research Cited

Poe emphasized that the natural-gas industry has maintained a broad program of technical research. He used a statement emanating from the coal industry to illustrate the success of the research program. R. A. Sherman, of Bituminous Coal Research, Inc., was quoted as having addressed a coal industry meeting with the comment, "The success that the competitive fuels have had in gaining markets that were formerly reserved for coal, is the result of the success that those industries have had in designing equipment to burn the fuels. The best coal that you producers can mine, prepare and ship will give only indifferent performance if the equipment in which it is to be used is not designed for that fuel."

"Unhealthy labor relations within the coal industry seem to me to be its greatest problem," Poe said. "It may be trite to say so, but it is truly an injustice to our country to slow the progress of the natural-gas industry that is operating dependably in the public service and permit the coal industry to go its wobbly way, suspending operations and blocking gas, both at the same time."

Poe told the Federal Power Commission that it was his opinion that there could be no permanent prosperity for the coal industry if it must rest on a foundation of unfair legislation and administrative restrictions imposed upon the natural-gas industry. "The natural-gas industry is not at all afraid of the competition of the coal industry. We feel that there is plenty of business for both, if the coal industry will only do its own share of the work in the true development of its share of the business."

Natural-gas service is available to approximately 68,000,000 persons in 33 states and the District of Columbia, Poe testified. In 1925, the areas having natural-gas service had a total population of about 21,000,000.

Poe was followed by E. DeGolyer, prominent consulting geologist, who presented detailed estimates of natural-gas reserves of the United States. At an earlier hearing in the FPC series DeGolyer had stated that we are justified in considering our gas reserves as in the neighborhood of 200 trillion cubic feet. He said

this is still a fair assumption, and his detailed survey showed that as of January 1, 1946, the United States has a proved recoverable gas reserve in excess of 144 trillion cubic feet. He concluded that natural gas will be able to supply the demands of an expanding market for the foreseeable future.

"The natural-gas reserves of the United States are estimated to be sufficient to meet demands for more than 30 years at the current rate of withdrawal and further substantial expansions of the reserves are anticipated," DeGolyer told the commission. "There should be no apprehension as to the ability of the industry to meet market demands in the foreseeable future."

Estimates made by several authorities since 1919 indicate an increasing trend of discovery, DeGolyer pointed out. "Developments during 1945 serve to support the opinion that natural-gas reserves will continue to increase for a considerable time in the future.

"Until quite recently, the oil industry was little concerned with gas. In the past, many gas shows were plugged and abandoned or neglected because of inaccessibility to market or the prevailing low prices paid for gas. This practice is not likely to continue in the future.

"We continually hear that if the use of natural gas is not restricted, the increasingly greater annual consumption will soon exhaust the gas resources of our nation," he commented. "On this point, it should be noted that the ratio of annual gas take to proved resources is twice as good as the similar ratio is for the oil industry."

DeGolyer was recalled for cross-examination, during which he was questioned as to the bases and methods used in arriving at his estimates of reserves, and the reasons for the changes of his reserve figures in the various sections of the country between his 1945 and 1946 estimates.

Tom McGrath, counsel for the coal interests, was unsuccessful in his efforts during lengthy examination, to discredit DeGolyer's estimates. In answer to a question, he said the Northern Great Plains to the Canadian line, and the Southeastern coastal section of the United States are the most likely areas for possible future new discoveries.

Louisiana Reserve Insufficient?

Leland Richardson, counsel for the State of Louisiana, suggested that deeper drilling in the South Louisiana area has resulted in the finding of more oil than gas, and suggested this would indicate that DeGolyer's opinion that deeper drilling will bring a large per cent of gas is incorrect, but the witness replied the South Louisiana and Texas coastal areas are exceptions to what will be found as the general rule, although he pointed out that 10 years ago there was no gas in South Louisiana.

Richardson attempted to show there is not sufficient gas in Louisiana to justify additional pipe lines from that state to distant markets, but DeGolyer said he would have to make a more thorough study of the entire situation before he could comment upon it.

A prediction that atomic energy will be supplying a considerable portion of the nation's power and heat requirements within a generation was furnished by a scientist brought in from outside the natural-gas industry—Dr. E. R. Gilliland, professor of chemistry at Massachusetts Institute of Technology. This testimony was given the commission by the gas industry to dispel the shibboleth that the nation will be powerless unless natural gas is locked up and saved for future generations.

Another M.I.T. professor, Dr. W. K. Lewis, outlined to the commission the technological and economic prospects for replacing natural gas with gas manufactured from coal, his conclusion being that natural gas need not be treated as an irreplaceable resource since the commercial production of synthetic gas is in no sense economically out of the question in the not distant future. Other witnesses and optimistically told the commission that their particular processes could achieve this result, and Dr. Lewis, speaking as an objective chemical engineer, declared that today it is technically feasible to manufacture from coal a synthetic gas with a heating value equal to or even higher than the natural product.

Detailed testimony more closely related to the present situation in the natural gas industry was presented by other industry committee witnesses, including J. E. Flanders of E. Holley Poe and Associates, and Charles R. Bellamy, independent consulting engineer.

Bellamy read papers on the industrial utilization of natural gas and a case study of natural-gas distribution. Flanders presented three different studies, covering development of natural-gas transportation in the United States, cost behavior of natural-gas transportation, and a case study in the transportation of natural gas.

The latest estimate of E. DeGolyer as to the nation's recoverable gas reserve is given in abbreviated form in the table below. The estimate, made at the request of E. Holley Poe and Associates, was presented last week in the Federal Power Commission hearing in Washington. The proved recoverable reserve of the United States was placed at 144,289,552,000,000 cu. ft. Except for the Appalachian area and the states of Illinois, Indiana, and Michigan, the estimate included only those fields with reserves of 20,000,000,000 cu. ft. or more. Reserves were calculated on a pressure base of 16.4 psi. and at 60° F. DeGolyer's earlier estimate of 140,859,000,000,000 cu. ft., together with his views on the subject, was published in The Oil and Gas Journal's Natural Gas Issue, page 80, May 4, 1946.

RESERVE AND PRODUCTION FIGURES IN 1,000,000 CU. FT.

Districts and gas-producing states—	Total recoverable solution and free gas reserve	Per cent of United States reserves	Est. gross gas production 1945
PAW District 1:			
Kentucky	.....	....	90,000
New York	.....	....	9,097
Ohio	.....	....	61,500
Pennsylvania	.....	....	95,361
West Virginia	.....	....	200,000
Total District 1	4,930,000	3.42	455,958
PAW DISTRICT 2:			
Illinois	237,500	0.17	49,000
Indiana	13,800	0.01	1,500
Kansas	13,955,339	9.67	171,000
Michigan	132,976	0.09	19,700
Oklahoma	6,771,172	4.69	370,000
Total district 2	21,110,787	14.64	611,200
PAW District 3:			
Arkansas	968,416	0.67	48,000
Louisiana	13,964,303	9.68	730,000
Mississippi	1,358,404	0.94	7,900
New Mexico	1,965,250	1.36	135,400
Texas	85,773,478	59.44	2,636,908
Total District 3	104,029,851	72.09	3,558,208
PAW District 4:			
Colorado	333,600	0.23	4,206
Montana	590,800	0.41	32,492
Utah	74,679	0.05	6,651
Wyoming	664,400	0.46	46,384
Total District 4	1,663,479	1.15	89,733
PAW District 5:			
California	12,555,435	8.70	560,820
Grand total United States	144,289,552	100.00	5,275,919

International

WORLD-WIDE OIL DEVELOPMENTS

Bolivia Resuming $17,000,000 Development Program

NEW YORK.—Bolivia's prewar $17,000,000 oil program for the extensive development of production, transportation, and refining—a program which was held up for the past 5 years due to lack of materials—is beginning to gather momentum with the ultimate aim of providing sufficient crude and petroleum products for internal consumption still the goal.

In making this statement to The Oil and Gas Journal, Jorge T. Lavadenz, president and director of Yacimientos Petroliferos Fiscales Bolivianos (Bolivian Government Oil Fields), explained that drilling plans for the Bolivian-Brazilian Mixed Commission was slated to start shortly. Lavadenz is in New York on a 2-week business trip. YPFB is the Government agency which handles all oil operations in Bolivia.

Concerning the proposed legislation to allow foreign oil capital to reenter Bolivia, Lavadenz said that the executive branch of the Government will ask Congress this fall to pass the bill. Moreover, the YPFB president said that the bill is practically certain to become law, with the result that mixed companies (YPFB and private capital) are expected to explore and develop vast areas generally regarded as excellent oil possibilities.

The Bolivian-Brazilian Mixed Commission, organized in 1938 in accordance with an international agreement between Bolivia and Brazil, will develop certain fields under its jurisdiction and then turn them over to mixed Bolivian-Brazilian companies for further exploitation. The wildcatting program is to be carried out exclusively by a United States contractor. YPFB's reserved zones approximate only one-fourth of Bolivia's probably oil-bearing structures, Lavadenz pointed out, with the Bolivian-Brazilian Mixed Commission having been assigned another one-eighth.

Plans to build a 5,000-bbl. daily refinery at Cochabamba, and to extend the crude pipe line from the Camiri oil fields to Cochabamba have been completed. Originally, it was announced that the line would go only to Tintin and that the crude would be transported from there by rail to Cochabamba.

The Cochabamba refinery, to be built by Foster Wheeler Corp., will turn out aviation gasoline and other petroleum products, and will contain a lubricating oil unit. Moreover, the refinery will be enlarged as soon as demand increases. One 1,000-bbl. topping plant will be built at either Zudanez or Sucre to supply products for local markets—mainly heavy products for mines in the Potosi area. The Camiri-Cochabamba pipe line will reach its maximum height, 9,500 ft., at Zudanez, and the necessary crude to run the 1,000-bbl. topping plant taken off at this point.

Extension to Be 340 Miles

The decision to extend the line 85 miles from Tintin to Cochabamba, Bolivia's second largest city, was due largely to the fact that Cochabamba is an important consumption center and has rail connections with all the other important mining centers. The line starts at an altitude of 2,700 ft., at Camiri, and with the extension will be 340 miles in length.

The $17,000,000 expenditure includes costs for drilling 50 additional wells, Lavadenz said. As crude from the Camiri fields yields a high percentage (about 65 per cent) of light products, two wildcats are now being

This group was photographed during the recent visit to the United States of Jorge T. Lavadenz, president of YPFB, Bolivian oil agency. Those shown are: Miller Williams, president, Williams Brothers Corp.; C. D. McCoy, manager of export sales, Foster Wheeler Corp.; A. B. Foy, vice president, Chemical Bank & Trust Co.; Lavadenz; C. E. McCulloch, petroleum refining division manager, Foster Wheeler Corp.; W. E. Rea, vice president, Williams Brothers Corp.; and Arturo J. Machicao, YPFB representative in the United States

drilled in a nearby structure in search of heavier crude. If heavier crude is not found, a feeder line will be built from Camiri to Camatindi, to the south, where there is proven production of heavier oil. The drilling program calls for six wells to be drilled simultaneously, for the present, and in about 3 months this will be stepped up to 10 wells. With the exception of one rotary rig, all other wells are being drilled with cable tools.

A sharp increase in Bolivia's domestic consumption is seen for the immediate future, Lavadenz said, due to current plans for stepping up numerous agricultural projects, as well as the highway construction already under way. A supply of cheaper fuel oil for the mines will help offset some of the increased mining costs as well as rail freight rates to Pacific ports.

YPFB Not a Monopoly

Lavadenz explained that while the opinion generally prevails in the United States that the Bolivian Government oil agency is a monopoly, this is incorrect. He pointed out that YPFB, a strictly industrial and commercial enterprise, has the support of the Bolivian people, but that foreign oil capital is not excluded, insofar as the importation and marketing of petroleum products is concerned. However, he added, the low cost at which YPFB sells its products makes it economically unsound for outside interests to compete, with the result that no private companies engage in distribution there. When foreign oil interests are permitted to reenter the country (with passage of the proposed oil legislation), their activities probably will exclude marketing.

It is pointed out that when YPFB's development program is in full operation the cost of petroleum products to the domestic trade will be substantially cheaper than imported products, and that because of this there will be no need for protective oil tariffs.

Some Bolivian oil is shipped in bond through an adjacent Argentina area, and north by railroad, up the west side of the Andes, to La Paz, and some moves northwestward overland by truck, but neither of these modes of transportation is very satisfactory, and with the completion of the 340-mile pipe line and the construction of the new refineries, this no longer will be necessary.

Trinidad Leaseholds Production Rises

NEW YORK. — Oil production by Trinidad Leaseholds (N. Y.), Inc., from its own fields totaled 499,455 bbl. for June, an increase of 18,399 bbl. over May. Daily average production in June was 16,111 bbl., and in May, 15,518 bbl.

Payment for Austrian Nationalization Seen

NEW YORK.—Whether the Austrian Government will devise some means of reimbursing outside private interests for properties seized under the proposed nationalization law now being rushed through Parliament, is not yet known. However, one well-informed oil company official here says that there is a good possibility of such a move (if Austrian industries are nationalized) in that the United States has already indicated its good faith in turning over to the Austrian Government valuable assets in the American zone of occupation.

The Zisterdorf oil fields, petroleum refineries, and numerous other industries which are now run under Russian direction would be included in the projected nationalization plans. Russia's desire to form a joint company, to handle oil properties in Austria has apparently been rejected. Meanwhile, Russia—despite its agreement to abide by the Potsdam Agreement, and other more specific agreements defining what constitutes bona fide German assets—continues to operate the Zisterdorf fields and direct the destination of oil produced and refined in Austria.

Czech Loan Is Factor

The U. S. Government loan to Czechoslovakia is said to be a contributing factor in Austrian plans to nationalize its industries, for prior to the loan some parties in Austria felt that the chances of obtaining such a loan would be less if nationalization went into effect. But since the loan was not withheld from Czechoslovakia, this "barrier" has been hurdled.

Just 2 days before the proposed nationalization plan was announced, Edwin W. Pauley, U. S. reparations representative at Potsdam, who was in Vienna July 17, said that "not by any conceivable interpretation of the Potsdam Agreement could such Austrian national resources as oil be considered German assets." Moreover, he said that the meaning of "German assets" had been discussed at length at Potsdam and that it had been agreed by all participants—including Russia—that Austria should be regarded as a liberated nation from which no reparations, as such, should be exacted and which should be helped to become strong and independent.

"It was agreed that to this end we should leave in Austria everything German-owned that we felt would help her become a strong nation with one exception—war-potential—which we decided to remove for other than reparations reasons," he said.

Concerning the Zisterdorf oil fields, Pauley said that "the Potsdam Agreement cannot possibly be made to cover natural resources such as oil. The Russian theory is that the Germans captured and took over the Zisterdorf oil fields, thus making them a German asset. I don't agree. In my opinion everyone at Potsdam clearly understood the definition of German assets in Austria as I have described it."

Creole's June Output Reaches New High

NEW YORK.—Daily crude oil production from Creole Petroleum Corp.'s Venezuelan fields, for the month of June, set another new high in reaching 570,040 bbl. This compares with May's daily output of 554,513 bbl.

Of the 570,000 bbl. total, 420,152 bbl. were from Lake Maracaibo and Cumarebo, with the remaining 149,888 bbl. from eastern Venezuela fields.

Daily runs to stills during June dropped to 61,845 bbl. compared with May's 65,459 bbl. A total of 52,504 bbl. daily were refined at the Caripito refinery and 9,341 bbl. at La Salina.

Four oil wells were completed during June, with no gas wells or dry holes. The fields where these wells came in, their average initial production and average depth follow: Jusepin, 9,411 bbl., 5,015 ft.; Mulata, 4,176 bbl., 5,001 ft.; and San Joaquin, 1,758 ft., 4,402 bbl.

In June, 1945, Creole's daily production was 445,722 bbl., of which 287,620 bbl. were from the Lake Maracaibo area and 158,102 bbl. from eastern and other areas.

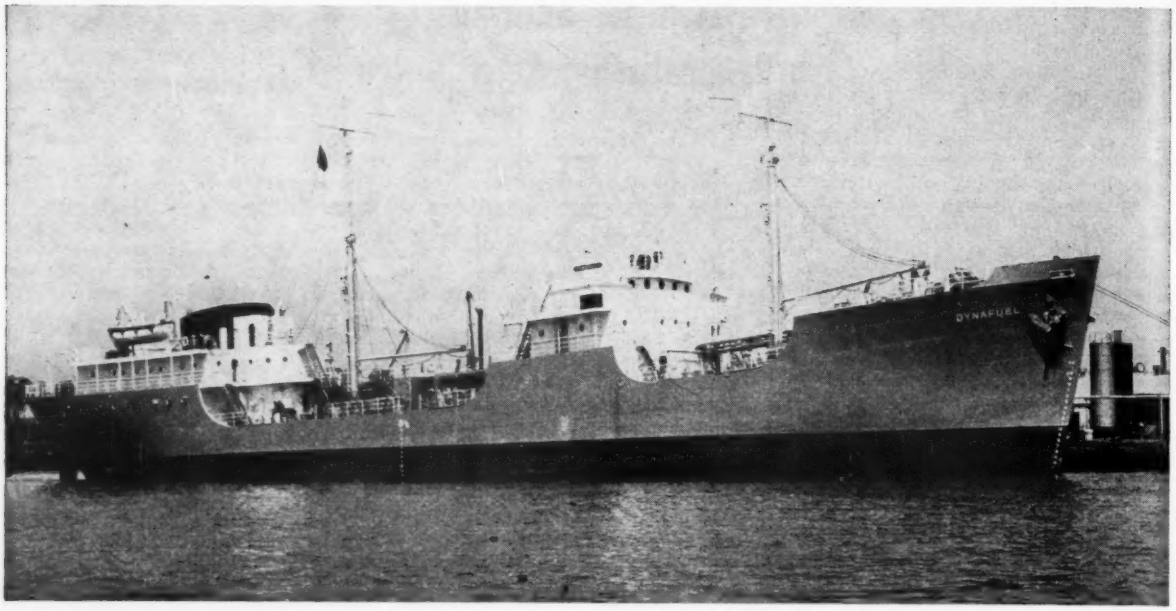
Iranian Production Resumed After Strike

Production has been resumed in the fields and plants of the Anglo-Iranian Oil Co., Ltd., following a 3-day general strike which British Embassy officials in Iran explained was for purely political reasons.

There were no reports of casualties among the Anglo-Iranian company's British and Indian staff, and no demonstrations on the company's Iranian oil properties.

Disturbance was said to be in surrounding areas. However, Tehran dispatches indicate martial law is still in force in south Iran.

Reports from Bagdad state that a 15-day general strike of workers of Iraq Petroleum Co., Ltd., ended July 18 after the Government intervened with conditions now said to be normal.



This tanker is M. S. Dynafuel of Sun Oil Co. Designed for Navy use in the Pacific, the hull was launched in April 1945. Sun purchased the uncompleted ship from the Maritime Commission. It is the first BT-1-type Navy tanker converted to peacetime commercial operation. Capacity is 30,000 bbl., gasoline, distributed among 12 cargo tanks

U. S. Government Continues to Hold Tanker Rates at Well-Defined Levels

by Warren W. Burns

NEW YORK.—On July 1, 1946, War Shipping Administration, as such, went out of business, but insofar as the availability of tankers is concerned, the U. S. Maritime Commission, which took over WSA activities, is slated to carry on—at least until December 31 of this year. The law now provides that after December 31, no additional government tankers will be sold to private ownership and voyage chartering will become history.

In the meantime, the U. S. Government remains in the tanker end of the business and as long as voyage chartering is carried on, the Government continues to hold rates at rather well-defined levels. In fact, the current rates—still referred to as WSA rates—assure owners who purchase government tankers of a somewhat certain income, for the time being at least. Then, it is the generally accepted opinion that current conditions justify the existing freight-rate levels.

Companies not owning their own tanker transportation either rely on spot charters or long-term contracts with private tanker owners. Naturally, the cost of tanker transportation to such charterers, under these circumstances, reflects exactly what the charterers pay. As for the cost of spot charters, this is currently around $2.85 per ton of 2,240 lb. for all petroleum products in bulk. This figure is based on WSA rates from U. S. Gulf-North of Hatteras (not north or east of New York).

Since this story was originally written, Congress has enacted temporary legislation extending the life of War Shipping Administration to Sept. 30, 1946.

Exactly what will materialize after December 31 is not at all certain in view of the declared statements of some government officials who believe that long-term postwar tanker transportation should be maintained "on a sound economic basis."

According to the law, the 590 government-owned tankers now on hand may be sold to private owners, but how soon even an appreciable number will be transferred to private ownership is unknown. The law also provides that government tankers may be sold to foreign as well as to U. S. private interests, but not until the latter have had sufficient time to make their demands known.

At least one exception to the 90-day clause has been made, for recently the Chinese Government purchased 18 shallow-draft tankers, the TI-MA-1 type, at a reported price of $300,000 each. Other foreign buyers for U. S. government-owned tankers possibly will be Norway, Sweden, Denmark, and other foreign countries. However, one well-informed source states that as most of the U. S. Government's tanker surplus consists of the T2-SE-A1 type, and as these have a draft of about 31 ft., such type tankers are unsuitable for all but the relatively few world ports with deep channels. However, these tankers are well suited to U. S. coastwise trade, and, of course, to certain foreign ports.

Justifying the U. S. Government's participation in the tanker trade, government officials point out that there is an insufficient number of private tankers to meet current oil-transportation demands. Under the

present setup, government tankers can be voyage chartered (in fact, this is the only way they can be chartered), after the applicant certifies that private tankers are not available.

Voyage chartering might possibly be called off before December 31 of this year, according to some Congressional sources, but it is hard to reconcile this view with the fact that there is now an insufficient number of privately owned tankers.

Of the approximately 590 government-owned tankers (all of those privately owned and used during the war by the Government having been returned to their legal owners), 317 are still in operation. Of the 317 total, 130 are under Naval jurisdiction; 100 are on U. S. coastwise runs; and 87 are in the foreign trade. Aside from the 8 tankers on loan to Russia, this would leave 265 laid up, but as accurate information on the actual number laid up is rather vague, well-informed sources say that the number is somewhat higher.

Regarding some foreign governments whose tanker operations are significant in the world oil trade, it is generally known that the desire to build up a U. S. dollar exchange is strong. Moreover, it is also known crude can be shipped more cheaply in foreign bottoms. The cost gap between U. S. and foreign-flag vessels revolves around crew wages, and crew wages on foreign-flag vessels range from 30 to 60 per cent below those of U. S.-flag vessels.

On the matter of building up U. S. dollar exchange, it is also pointed out that Swedish and Swiss currency exchange is regarded, by some governments, as more desirable than U. S. dollars. Be that as it may, the fact is that foreign tankers can operate at appreciably lower costs, and because of this, considerable speculation persists as to whether Middle Eastern crude will, at some future date, move into markets on the U. S. East Coast.

Sulfur Content Significant

So many factors are involved in this speculation that it is possible to make out a plausible case for or against such Middle East crude movement. For instance, most East Coast refineries in this country are designed to run on crude of a relatively low sulfur content, and one school of thought points out that because of this there is little likelihood of much Middle East crude moving in here in the near future because of the comparatively high sulfur content of crude from that area. Offshore shipments of Arabian crude are now first treated at a stabilizing plant, at Dhahran, completely removing the dissolved hydrogen sulfide. This practice has been followed with Iraq crude oil for several years.

And while it is pointed out that certain French interests are currently in this country to purchase sweet Texas crude this cannot be used as any conclusive statement that the movement of Middle East crude to the U. S. East Coast, Canada, and Europe, won't be stepped up in the near future. During the war, the Petroleum Administration estimated that from 200,000 to 300,000 bbl. daily of sour crude could be handled by U. S. East Coast refineries.

Again, it is stressed that the economic factors involved in the Middle East crude movement to U. S. East Coast ports are many, and that such movement, in relatively large amounts, always constitutes a "threat." More information on the manufacturing phase will be available sometime after August, for Gulf Oil Corp. plans to ship 100,000 bbl. of Kuwait crude to Philadelphia to use in a test refinery run. A Gulf official states, however, that no additional shipments are anticipated for the remainder of the year. The Kuwait crude comes from the Middle East concession which Gulf Exploration Corp. (Gulf Oil Corp.), holds jointly with Anglo-Iranian Oil Co., Ltd., and which went into production early in July.

No Persian Gulf Rate at Present

Currently there is no WSA tanker rate from the Persian Gulf to any East Coast port of the U. S. or Canada. However, a recent request for such a rate drew a government estimate of $1.70 per barrel. The project reportedly was dropped.

In discussing Middle East versus Gulf Coast crude costs to the U. S. East Coast area, it is pointed out that the often-quoted figure of 10 cents per barrel for Middle East crude production, exclusive of royalty charges, is not a fair estimate, for such a figure fails to take into account such costs as the millions of dollars spent in exploration plus the expenditures for recreational and housing projects which the oil companies built and continue to maintain.

On the other hand, some officials of oil companies operating in the Middle East point out that if Middle East crude producers tried to sell on an all-inclusive production-cost basis they would soon go out of business for lack of customers—at least as long as crude from other world areas was being offered on the market.

Looking into the future when U. S. East Coast refineries might be handling relatively large Middle East crude imports, the question is sometimes asked as to what action U. S. producers without Middle East interests, might take in the matter. And generally speaking, it is believed that such producers would take the matter up with Congress and that Congress would slap an import quota on Middle East crude. At present no such quota exists, and the import tax is only 10.5 cents per barrel for crude, compared with a prohibitive $1.05 per barrel for gasoline.

It is perhaps interesting, in considering foreign crude imports to the U. S., to note that the cost of shipping crude from Venezuela to New York is approximately the same as from the Gulf to New York. This year's crude imports (largely from Venezuela), through the month of April, totaled 29,849,000 bbl., compared with 19,069,000 bbl. for the same period in 1945.

California Standard, Texas Organize Tanker Company

NEW YORK.—To transport crude and products throughout the world, the Standard Oil Co. of California and The Texas Co. last week announced the joint formation of Overseas Tankship Corp. It has an authorized capital of $2,000,000 and a paid capital of $100,000.

Application to buy tankers from the U. S. Government's surplus has already been made, but the type being sought was not disclosed. Overseas Tankship is under Panamanian registry, and its ships will move crude and products produced and marketed by the joint foreign interests of Texaco and California Standard. Headquarters will be in New York City.

W. H. Pinckard is board chairman and C. E. Olmsted, president. The directors are H. M. Herron, B. W. Letcher, J. H. MacGaregill, J. H. Ruskin, and A. E. Van Dusen. A. E. Thayer is secretary and a director, with William Kunstadter as treasurer and comptroller.

Creole Says Amuay Bay Refinery Site Favored

NEW YORK.—The Amuay Bay area of the Paraguana Peninsula in western Venezuela is favored for the site of its new $65,000,000 refinery (see The Oil and Gas Journal, July 20 issue, page 66), according to an announcement this week by the Creole Petroleum Corp. Final approval of the site rests with the people in that area, and the announcement expresses hope that the residents will realize the great economic benefits which will result from the construction of the refinery at that point.

The company will build a town capable of housing 10,000 people, according to W. J. Connelly, manager of the manufacturing division. Two thousand houses will be built. The entire project is said to be the largest in the history of the petroleum industry in South America.

WASHINGTON WATCHING

BY HENRY D. RALPH

Oil and OPA's Revival

WASHINGTON. — The oil industry is reasonably sure of being free from price controls under the terms of the new OPA extension bill as rewritten by the House and Senate conferees.

The conference bill retains the Moore amendment removing price controls from petroleum and petroleum products but provides that at any time in the future ceilings may be placed on any oil product if the new decontrol board finds that the price has gone up unduly, the supply is short of demand, and resumption of control is in the public interests. Some of the food products specifically named in the bill are to remain without controls only until August 20 unless the board sets a later date for reimposition of ceilings, but this date does not apply to petroleum.

The conference report was taken up by Congress Tuesday amid general predictions that it would be speedily passed and would obtain the signature of President Truman.

Tideland Resolution Voted

THE Senate Monday passed the controversial tidelands resolution denying that the federal Government has any claim to submerged lands below the low-tide mark and the international boundary.

The measure was returned to the House for action on the single Senate amendment, one sponsored by Senator O'Mahoney of Wyoming asserting federal claim to the bed of the ocean on the continental shelf beyond the 3-mile limit international limit or whatever ocean boundary is claimed by individual states. This amendment has no effect on the controversy over other submerged lands and simply gives congressional approval to the Presidential proclamation asserting ownership of the continental shelf.

Senate Leader Barkley asserted flatly that the bill will be vetoed by President Truman. While the measure passed by the House by an overwhelming vote last spring the Senate vote was 44 to 34, or less than the two-thirds required to override a veto.

Barkley fought the resolution during the 3 days of debate, pleading that Congress let the Supreme Court decide whether title to submerged lands rests with the states or the federal Government. He introduced amendments to drop federal claims to all river and harbor submerged lands, and to all coastal lands except those of California, but these were defeated. He used the argument that the resolution would "give away" millions of dollars worth of oil and other lands owned by the Government, while supporters of the measure insisted that in 54 cases the Supreme Court has uniformly ruled that states have title to all submerged lands.

If the resolution becomes law it will nullify the Government's suit pending in the Supreme Court which asserts federal claims to off-shore oil-producing lands of California.

Philosophy of Oil Hoarding

PETROLEUM is something to be locked up and hoarded and not used at all, under the New Deal philosophy which pervades so much of the thinking of government officials these days, showing that the oil industry still has a big public relations job to do.

The Army and Navy, according to official statements filed with the O'Mahoney committee, are on record as being converted to the belief that active production capacity is a better military safeguard than undeveloped potential reserves in the ground, but this idea has not yet gained general acceptance.

An illustration is the remarks of Majority Leader Alben Barkley in opposing Senate action on the tidelands bill the other day. Senator Barkley, who comes from the oil-producing state of Kentucky and should know better, trotted out the old hoarding theory as an argument why the federal Government rather than the states should have control of submerged oil deposits. The Senate leader has been pretty busy these days, and the material for his speech in opposition to the tidelands bill probably was handed to him by some "Congressional liaison" man (lobbyist) from one of the executive agencies. At any rate, he told the Senate:

"It seems to me that, as a matter of policy, and aside from the legal question involved, if the Government of the United States has a legal right to this 3-mile strip and the petroleum which may lie under it, we ought to conserve that supply of oil for whatever uses we may have for it in the future—for our Army, our Navy, or our people—rather than give up title to it if we are entitled to it. That is a legal question. We should not permit that oil to be dissipated and used up, and then cruise all around the world, trading with other nations in order to obtain a supply of oil thousands of miles from the United States."

This statement embodies the utterly cock-eyed but very persistent theory that if oil is produced by a private corporation under a state lease it isn't used by "our Army, our Navy, or our people." Just where such oil does go is never explained, but the inference is that if the federal Government owned it the oil would be used by "our people."

Either the Senate leader was talking off the cuff, grasping blindly at any argument in an effort to support the administration position on this measure, or else he was reflecting the inside plans of the Interior Department to stop all production of oil off the coasts of California, Louisiana, and Texas if the federal Government ever gets the legal power to do so. Such locking up of all off-shore oil development would be ironical, to say the least, because the entire question over state versus federal ownership of submerged oil was raised by private operators who for years have been trying to get California leases invalidated so they can obtain federal leases to get hold of this same oil for their own purposes. If it were not for these would-be exploiters the federal conservationists never would have got the idea that the federal Government has a shadow of a claim to off-shore oil.

Ten Big Inch Bids

BIDS for the big-inch oil pipe lines are still coming in as the July 30 dead line nears, and War Assets Administration expects to have at least a dozen firm offers.

Two weeks before the closing date WAA announced it had seven proposals to purchase and three to lease, and also that it had received 12 inquiries indicating that purchase bids would be filed and five letters signifying intent to submit lease offers. This is taken as demonstrating the wisdom of WAA's decision to impose a cut-off date on bids for the two war oil carriers. Before this was done most potential purchasers appeared to

be playing coy and waiting for some one else to start the bidding.

Details of the proposals will not be revealed until the bids are publicly opened July 31, but WAA says that four of the prospective purchasers have let it be known they intend to use the lines as oil carriers, two want them for natural gas, and one proposes to move one of the lines for use in carrying oil elsewhere.

U. S. Tanker Applications

APPLICATIONS to purchase 56 surplus tankers of various types are on file with the U. S. Maritime Commission, but no tankers (nor any other surplus ships) have been sold because of technical difficulties with the regulations.

The commission has been working intensively on this problem for some time and may be ready to announce its policy and amended regulations very shortly and then start acting on the 1,246 applications to purchase or charter ships of all types which were pending July 1. For preference purposes applications are batched by calendar months, so another large group of applications will be ready for action on August 1.

To protect applicants from embarrassment the commission does not announce the names of those desiring to purchase, but a number of oil companies have publicly stated that they are attempting to purchase government tankers.

The biggest difficulty will come in disposal of T-3 type tankers, the large, fast, latest-model tank ship built to keep up with the fleet. There are already 18 applications to purchase T-3's, but only 5 have been declared surplus. The rest are still being used by the Army, Navy, or Maritime Commission, and no one knows when more will be released. Of the five available, only two are merchant types.

There are plenty of other types of tankers available to fill the present applications for purchase, as shown in the following table:

	T-2	T-3	Special	Liberty	Coastal T-1	Total tankers
Applications:						
U. S. registry	35	16	2	1	2	56
Foreign registry	21	2	1	..	6	30
Total	56	18	3	1	8	86
Available:						
Merchant type	440	2	2	42	20	506
Military type	29	3	..	19	11	62
Total	469	5	2	61	31	568

East Texas Wells, Tract In Rio Grande Valley Sold

DALLAS.—Producing properties in the East Texas field and land in the Rio Grande Valley area were involved in oil transactions disclosed last week.

A. H. Meadows, Dallas operator, purchased all stock of Haynes Oil Corp., Shreveport, La., for a reported $1,500,000. Properties include 37 wells in East Texas field. Cash and bonds valued at $600,000 were included in the deal. General American Oil Co., headed by Meadows, operates nearly 200 wells in the East Texas field.

In Mercedes, it is announced Roger Lacy, Longview oil operator, has purchased 9,000 acres of land north of Mercedes from American Rio Grande Land & Trust Co. for an amount said to exceed $400,000. Lacy was reported planning an immediate start on drilling operations on the tract.

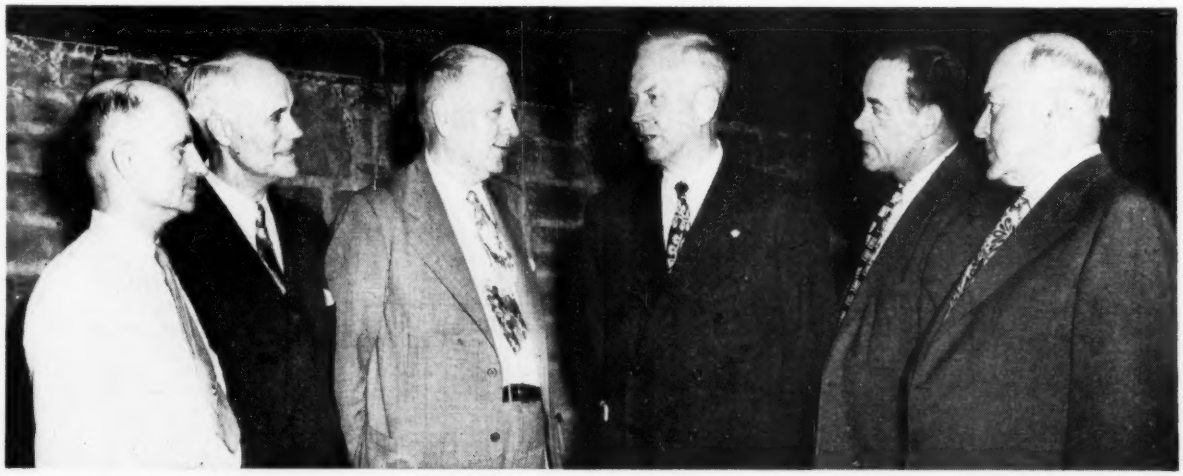
Work Started on New Texas Chemical Plant

MIDLAND, Tex. — Construction work has commenced on a new $500,000 electrochemical manufacturing plant at Denver City in south-central Yoakum County.

The plant being built by Frontier Chemical Co. will produce hydrochloric acid and caustic soda from salt brines for use in oil field and refining operations in the West Texas-New Mexico Permian basin. Capacity of the plant is placed at 25 tons of concentrated hydrochloric acid and about 10 tons of caustic soda daily.

I.P.A.A. Group to Meet July 30-31 in Cheyenne

Plans for the annual meeting of the Independent Petroleum Association of America October 28-30 in Fort Worth will be studied at a meeting of the executive committee and state vice presidents of the organization at the Plains Hotel July 30-31 in Cheyenne, Wyo.



More than 350 operators from Ohio, West Virginia, and Pennsylvania met last week in Granville, Ohio, for the fourteenth annual meeting of the Independent Gas Producers Association of Ohio. Guest speaker was Edward Martin, Pennsylvania governor. The program included golf, luncheon, and a dinner followed by a business meeting at which Ralph Burns, Sistersville, W. Va.; Clyde M. Foraker, Columbus, Ohio; William A. Post, Pittsburgh, Pa.; and Willard Shrider, Newark, Ohio, were elected association directors and George Weaver, Newark, Ohio, reelected a director. Among those at the meeting was the group shown above—George Weaver, who is treasurer of the association; J. A. Upham, Mt. Vernon independent producer; D. T. Ring, president, Pennsylvania Grade Crude Oil Association; Governor Martin; Phil Faine, secretary of the association, and Freeman T. Eagleson, chief counsel for Ohio Fuel Gas Co.

Demand for Lube Oil Described as Heavier Than War Peak

by Dahl M. Duff

MIDYEAR REPORT
STARTS NEXT PAGE

KEROSENE, No. 2 burning oil, and residual showed further signs of seasonal weakness in oil markets this week, while gasoline and lubricating oil prices held steady under continued strong demand.

One informed marketer pointed out kerosene, which has been going to storage, is being offered by smaller refiners without large storage capacity. Offers of kerosene at 4⅜ cents, Group 3, and 4½ cents, Shreveport, were reported.

No. 2 appeared to be in somewhat more plentiful supply in the Mid-Continent area. The product was said to be obtainable at 3¾ cents. Residual fuel oil, much of which is sold to railroads under contract at $1.05 per barrel, was reported bringing about the same price elsewhere.

All these products were in heavy demand a few months back, and their position in the market is expected to begin strengthening within a few weeks at the approach of the heating season. American Petroleum Institute figures for the week ended July 13 showed an increase in kerosene stocks of 663,000 bbl. to a total of 14,879,000 bbl.

No sales above the former ceilings in gasoline or lubricating oil were reported, although one Oklahoma refiner withdrew a previous above-ceiling quotation with the statement that it was "a mistake." Market observers believed that, with the present demand situation, gasoline could easily go above the now-defunct ceilings were it not for the unsettled status of price control in Washington, and a general "hold the line" tendency in the industry.

Lubricating oil was described as "extremely tight." One large Mid-Continent supplier said demand was heavier than it ever had been during the war. Refiners were reported weeks behind on orders, and difficulty in getting cans was making the shortage even more acute.

Greater - than - anticipated military requirements, export shipments, as well as the boom summer automobile travel, lay behind the demand for lubricating oil. Pennsylvania-grade neutrals last week rose a cent to reach the level of the former ceilings.

Practically all gasoline was moving at 6 cents for regular in the Mid-Continent area. Where formerly some material could be found ¼ cent under this figure, little if any was available, even for resale, at ⅛ cent below. One buyer said the only material offered on the open market was some recycle material in East Texas.

In New York, little activity in residual, No. 2, or kerosene was reported. Stocks were continuing to build up with the three products described as "tight." Prices in all products were unchanged. Gasoline demand continued moderately strong.

For the week ended July 13, daily gasoline demand, on the basis of A.P.I. figures, was calculated at 2,239,000 bbl.—an increase of 100,000 bbl. over the total for the preceding week.

Stockholders Vote Merger Of Sunray, Transwestern

NEW YORK.—Merger of Transwestern Oil Co. into Sunray Oil Corp., effective July 31, was formally approved last week at a special meeting of Sunray stockholders in Wilmington, Del., and a meeting of Transwestern stockholders in New York.

Under terms of agreement, Sunray will absorb producing properties owned by Transwestern in four states and nonproducing acreage in nine states. Transwestern stockholders are surrendering the 750,000 shares outstanding in that company in exchange for 525,000 shares of new Sunray preferred stock, with a par value of $100 per share.

May Petroleum Imports Show 22 Per Cent Rise

WASHINGTON. — May petroleum imports into the United States totaled 12,450,000 bbl., an increase of about 22 per cent over the previous month.

Data prepared by the Independent Petroleum Association of America from figures furnished by the Bureau of Census show May daily average imports were 402,000 bbl. Total imports for the first 5 months of this year amount to 56,369,000 bbl., nearly 30 per cent above the same period of last year and approximately double the rate during the 5 prewar years. Crude showed a slight drop in May, while refined products, mostly residual, increased.

Detailed import figures are given in the following table:

(All figures in thousands of barrels)

	May 1946 Total	May 1946 Daily avg.	April 1946 total
Total imports	12,450	402	10,165
Imports by products:			
Crude petroleum	7,784	251	7,867
Distillate fuel oil	673	22	251
Residual fuel oil	3,786	122	1,883
Asphalt	40	1	109
Unfinished oils	167	6	55
Total refined	4,666	151	2,298
Imports by countries:			
Venezuela	6,608	213	6,714
Netherlands W. Indies	4,178	135	2,024
Mexico	778	25	501
Colombia	886	29	926
Imports by tax classification:			
Taxable for domestic consumption	9,510	307	8,723
Free for vessels	2,382	77	1,278
Free for Govt. use	558	18	164

DEATHS

George T. Randolph, 57, veteran oil operator in the Owensboro, Ky., field, died in Owensboro July 15.

L. G. Wilson, 86, retired independent oil operator, died July 16 in Tulsa.

L. C. Carter, former Tulsa gasoline broker, died July 13 in McAllen, Tex.

John Ort, 77, Allegany, N. Y., associated with South Penn Oil Co. prior to his retirement, died July 15 in Olean, N. Y.

Edward G. McCoy, 78, retired drilling contractor, died July 18 at his home in Tulsa.

Thomas E. Cyphert, 57, veteran driller of Fisher, Pa., died July 15 at Kane Summit, Pa. At the time of his death, Cyphert was employed by Wassum Drilling Co.

Wilburn W. Jamieson, 64, oil operator, died at his home in Owensboro, Ky., on July 17.

Mrs. B. L. Majewski, wife of the vice president of Deep Rock Oil Corp., died on July 17 as a result of injuries sustained in a boating accident at Algonquin, Ill.

George W. Burley, 62, assistant treasurer of Stanolind Pipe Line Co., died July 22 in Tulsa.

WORLD *Demand*

FOR PETROLEUM PRODUCTS EXCEEDS WARTIME PEAK

"HIGHER than anticipated" is the phrase that recurs constantly in reports on postwar demand for petroleum from all parts of the world. Viewing a mechanized war in which petroleum products were the greatest single material required by a wide margin, and looking at the volume consumed by civilians in indirect war effort, it had seemed inevitable that there would be a substantial drop in the world's petroleum requirements during the reconversion period. No one was sufficiently optimistic to forecast what has actually happened.

As was the case during the war, the strong position of petroleum uses in the United States is outstanding in postwar developments. From 1938, the last peacetime year before the start of World War 2, to 1945, petroleum demands in this country (domestic plus exports) increased 1,700,000 bbl. daily or nearly 50 per cent. There was a steady growth in domestic requirements in this country through 1941 with the war demands getting under way in late 1942.

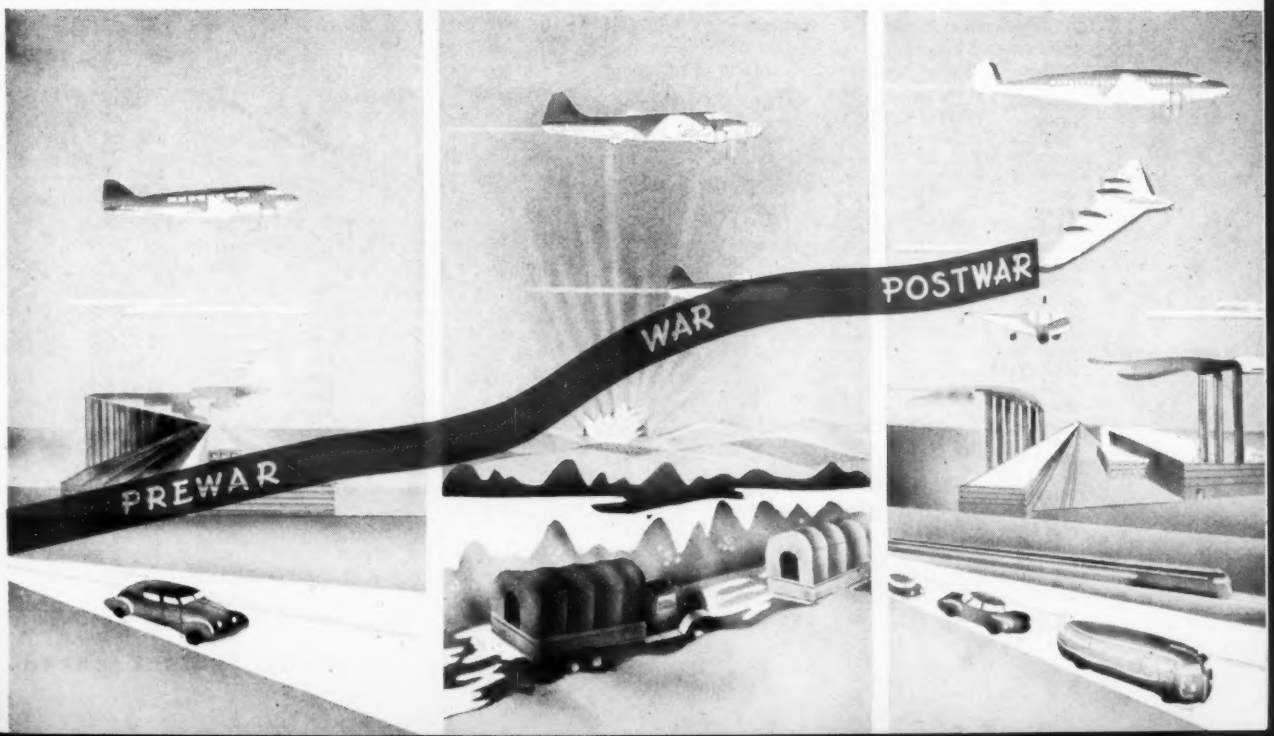
While Allied war needs constituted a substantial part of the 1945 demand, civilian requirements have largely offset the war losses so far this year. Aviation-gasoline requirements have decreased to a small fraction of the war consumption but other military outlets have not shown the decline that was expected. This is particularly true of the U. S. Navy and British consumption of fuel oil and diesel fuel. Navy and other shipping consumption of fuel oil is now estimated to exceed that during the war period.

Since the close of the war civilian petroleum requirements in this country have been surprising to distributors everywhere. With the lifting of rationing restrictions it soon became apparent that the gain in gasoline consumption per motor vehicle would offset the decline in number, a decrease being brought about by the fact that fewer units were built during the war. The same situation applies to practically every other outlet for petroleum products including furnace oils, burning oils, and residual fuels.

In the first half of 1946 civilian gasoline consumption is up 5 per cent over 1941, according to preliminary estimates. Kerosene demand has increased 7 per cent while heating oil, diesel fuel, and distillate demand is up a thumping 18 per cent, and a reconverting industrial system is burning up 19 per cent more residual fuel oil. These demands, on top of the still high military consumption, account for the situation in the United States.

Outside the United States, except for war-devastated areas, conditions in postwar petroleum consumption have been comparable to those in this country. Except where rationing is still effective civilian demands have increased.

In regard to the immediate future, requirements continue to be headed in one direction—upward, for civilians at a rate that will more than exceed the slow decrease in military requirements.



Production

by Charles J. Deegan

THE first half of 1946 versus the first half of 1945 affords the first opportunity to make a direct comparison of peacetime production operations with a similar wartime period. The results are far more optimistic than had been anticipated. Production in the first 6 months of 1946 was 846,538,000 bbl., a drop of only 23,264,000 bbl. from the 1945 period total of 869,802,000 bbl. This is a decrease of less than 3 per cent, 2.7 to be exact.

The domestic industry entered the year with production hovering around the 4½-million-barrel-per-day mark, a plateau that seemed to have been fairly well established following the cutback at the end of the war, and by operations through the early winter months at the end of 1945. Demand, however, seemed to be holding up higher than anticipated, partly due to higher sustained military requirements, and since crude stocks were at an uncomfortably low working level for normal peacetime operations, a crude-stock buildup started. This required more production, and after a slow rising trend in January, a sharp jump took place in February.

Crude stocks then began to build up rapidly and production was soon cut back sharply, to a point below the beginning of the year. However, by May, the rapid reconversion of industry, and the greater-than-anticipated increased demands from many sources, caused this cut to be restored. From then until the middle of the year production rose steadily, until it passed the wartime peak, and still no unusual crude stock buildup was evident.

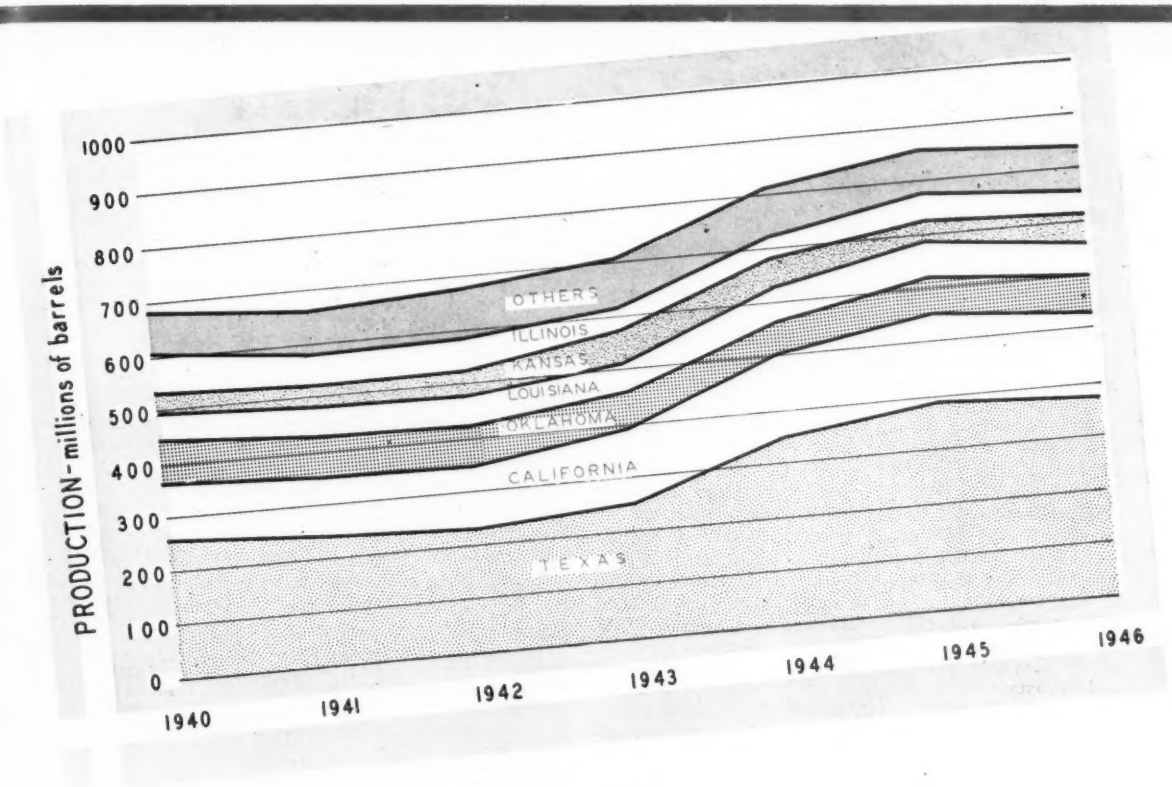
There appears to be every reason to anticipate that the present rate of production, about 5,000,000 bbl. daily in round figures, will continue at least through the summer months, and possibly throughout the entire last half of the year. This compares with an average of 4,677,000 bbl. daily for the entire first half.

The pattern of change in production during 1946 compared to the same period in 1945 was concentrated in nine of the producing states; the big six of Texas, California, Oklahoma, Louisiana, Kansas, and Illinois, plus three others, Colorado, Indiana, and Mississippi. The 23,264,000 bbl. total drop was distributed as follows: Texas was down 20,154,000 bbl.; California down 11,046,000 bbl.; Kansas down 2,036,000 bbl.; Louisiana reversed the trend and was up 4,624,000 bbl.; while the remaining two of the big six producers had small changes, Oklahoma and Illinois both being up slightly, 247,000 bbl. and 192,000 bbl. respectively. Outside the big six, three other states had noticeable changes. Colorado was up 2,716,-

PRODUCTION CRUDE OIL—FIRST HALF YEAR
(Thousands of barrels)

	Six months						Cumulative production 1859-7/1/46
	1946	1945	1944	1943	1942	1941	1940	
Alabama	191	79	8	.....	.....	.....	.....	415
Arkansas	14,042	14,493	14,579	13,314	13,233	12,846	12,664	659,045
California	154,755	165,801	151,049	139,839	114,511	111,849	111,221	7,125,885
Colorado	4,548	1,832	1,354	1,085	1,057	781	636	59,016
Florida	27	11	8	.....	.....	.....	.....	69
Illinois	37,684	37,492	39,095	41,919	57,871	60,954	78,745	1,211,023
Indiana	3,475	2,365	2,559	2,694	3,557	3,376	1,732	164,008
Kansas	46,444	48,480	49,553	54,712	45,100	37,612	31,323	1,649,122
Kentucky	5,303	4,959	4,232	3,467	2,114	2,420	2,550	209,589
Louisiana	68,870	64,246	64,285	59,897	57,860	55,325	52,093	1,743,917
Michigan	8,326	8,710	9,445	10,566	10,357	6,964	11,057	248,062
Mississippi	10,461	9,154	7,667	9,940	15,862	4,240	1,341	113,047
Montana	4,506	4,214	4,337	3,737	3,980	3,575	3,348	128,538
Nebraska	147	159	208	378	701	642	.....	4,917
New Mexico	17,451	18,847	20,284	18,036	15,228	19,127	20,121	479,055
New York	2,425	2,263	2,363	2,555	2,692	2,499	2,611	146,212
Ohio	1,412	1,391	1,500	1,626	1,771	1,616	1,501	605,929
Oklahoma	67,748	67,501	60,703	61,812	71,615	75,875	78,800	5,555,067
Pennsylvania	6,480	6,279	7,296	8,089	9,015	8,117	9,059	1,080,467
Texas	371,596	391,750	355,771	257,977	236,694	243,220	255,357	10,038,070
West Virginia	1,448	1,450	1,570	1,707	1,787	1,681	1,707	428,523
Wyoming	19,175	18,299	15,667	15,965	15,499	14,588	11,984	684,843
Miscellaneous	24	27	24	27	32	31	51	1,409
Total U. S.	846,538	869,802	813,557	709,342	680,536	667,338	687,901	32,336,298

ONLY 3 PER CENT LOWER THAN AT WARTIME PEAK



000 bbl., Mississippi was up 1,307,000 bbl., and Indiana was up 1,110,000 bbl.

On net balance, these nine states accounted for a drop of 23,040,000 bbl. out of the total United States decrease of 23,264,000 bbl. The remaining states then just about balanced off the same in 1946 as in the previous year. Or, to put it another way, the two states, Texas and California, that shouldered the burden of supplying the big increases during the war, eased off 31,000,000 bbl. in round numbers, to give their fields a breathing spell, while the rest of the country picked up about 8,000,000 bbl.

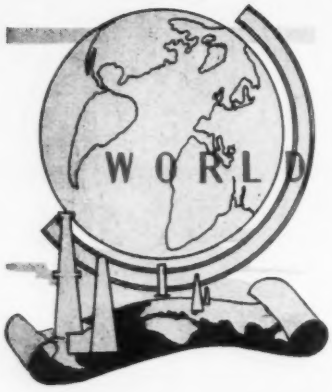
In Texas most of the operators welcomed a breathing spell at the end of the war. Some of the big fields had been pulled heavily during the war, and while it was questionable whether they had actually been damaged by being produced beyond maximum efficient rates, there certainly was no margin of safety, such as any prudent operator would like to have in handling his best properties. A substantial portion of the drop in Texas production came in such fields as East Texas, Wasson, Agua Dulce, Tom O'Conner, and West Ranch.

In California the bulk of the reduction was accounted for by the shutting in of the Elk Hills Naval Reserve, which after much government red tape, had finally gotten into production near the end of the war, to supply some of the war oil for which it was supposed to be held. That experience with government-owned oil reserves for use in time of war appears to have impressed many government officials and at least some of the military with the futility of such measures in meeting war requirements. The theory sounded good; in practice it failed.

The prospective production for the last half of 1946 will require a lot of development work in fields that are only partially defined at this time, plus a very active search for new fields. With materials and skilled manpower easier to get and mobilize than during the war, the increased production may come from more rapid development of newly discovered fields than has been the case since the war began. Certainly the industry would like to have more proven reserves and more potential production back of the current and prospective high rates of production than existed during the latter part of the war.

The ratio of proven reserves and available efficient production to the daily output is just as much a function of balanced operations as normal working stocks of crude and refined products. All are part of the normal working inventory. During the war all were pared to the bone, with the industry working on a hair-line margin. This strain cannot be continued during peacetime. Therefore, the increased production requirements must be and will be balanced by an even larger increase in available production and proven reserves.

At the midyear turning point, it is obvious that the cautious development and wildcatting budgets of the first of the year have already been enlarged. The prospects for the last half of the year and the long-term prospects of the next few years indicate that the industry's postwar breathing spell is over. Postwar production requirements are definitely on an even higher scale than the wartime peaks.



Production

by Warren W. Burns

WORLD crude-oil production is rapidly approaching 8,000,000 bbl. daily, a yearly rate which, if the output of natural gasoline and associated products is added, means that global supplies of liquid petroleum will shortly be at the rate of 3 billion barrels yearly.

Current world output is estimated to be 7,805,800 bbl. daily. This figure includes a production of only 44,000 bbl. daily estimated for the Far East. The prewar production of the same area was approximately 225,000 bbl. daily. Rehabilitation work of the oil fields and refineries, practically all of which was taken over by the Japanese, is under way and it is expected that production will be back to the prewar basis by the end of 1947. The current production of 85,000 bbl. in Rumania is about 50,000 bbl. daily less than the prewar average. This in effect means that when the crude-oil production of war-devastated countries is added to the present output, world output will reach the 8,000,000-bbl. daily figure. This projection assumes that world demands will continue to expand.

This discussion is concerned with petroleum developments outside the United States the first 6 months of this year. Data on domestic operations appear elsewhere in this issue. Global output outside this country as shown in the accompanying table averaged 2,766,700 bbl. daily the first 4 months of this year with current output estimated to be 2,865,800 bbl. daily. These totals compare with 2,119,000 bbl. daily for 1938, and 2,219,000 bbl. daily for 1941.

The increase in world petroleum output of 25 per cent outside the United States since 1941 is largely accounted for by the expanded operations of Venezuela, Iran, and Saudi Arabia. There have been small increases in several countries but over 90 per cent of the world expansion in petroleum output since 1938 and 1941 is accounted for by enlarged operations in the United States, Venezuela, Iran, and Saudi Arabia, in the order named.

Venezuela's current crude-oil production of 1,052,700 bbl. daily is 400,000 bbl. daily higher than it was in 1941 and nearly 100 per cent greater than it was in 1938. A large part of the increased output of recent years comes from new fields in Eastern Venezuela.

Production of Iran is now nearly double what it was before the start of the war. The enlarged output is coming from fields which were discovered prior to 1940. Anglo-Iranian Oil Co., Ltd., which is the only operating company in Iran, has plans calling for exploration in new parts of its concession and the further exploitation of its proven fields.

Saudi Arabia, whose output was less than 1,500 bbl. daily in 1938 and approximately 15,000 bbl. daily in 1941, is now an important source of petroleum supply with a current production of 170,000 bbl. daily. Until early this year Saudi Arabia was a one-field oil area. Two additional large fields are now producing and the new refinery at Ras Tanura is refining in excess of 80,000 bbl. daily. Just before the half year ended facilities were completed for the delivery of crude oil from a large reserve in Kuwait on the Persian Gulf.

ESTIMATED FOREIGN CRUDE-OIL PRODUCTION
(Thousands of barrels 42's daily)

	Four mos. 1946	Current production
Canada	20.0	22.0
Mexico	121.0	115.0
Cuba	.2	.2
Total North America (outside U. S.)	142.2	137.2
Colombia	62.4	62.0
Trinidad	55.0	55.0
Venezuela	1,018.7	1,052.7
Total Caribbean	1,136.2	1,169.7
Argentina	59.0	61.5
Peru	34.9	34.5
Other Latin America	7.9	8.0
Total other South America	100.8	103.5
Western Hemisphere (excl. U. S.)	1,379.2	1,409.5
Austria	20.0	20.0
France	1.1	1.1
Germany	12.0	12.0
Great Britain	1.5	1.1
Hungary	18.0	18.0
Romania	86.0	85.0
Others	3.5	3.5
Total Europe (outside U.S.S.R.)	142.2	140.8
Egypt	25.0	25.0
Iraq	35.2	35.0
Iran	460.0	460.0
Bahrein-Arabia	148.0	190.0
Total Middle East	661.2	711.0
N.E.I. and British Borneo	30.0	30.0
Burma	1.0	1.0
China	2.0	2.0
India	7.0	7.0
Japan	4.0	4.0
Total South and East Asia	14.0	14.0
Foreign, excl. U.S.S.R.	2,226.7	2,313.0
U.S.S.R.*	540.0	550.0
Total foreign	2,766.7	2,865.0
United States (first 6 months)	4,577.0	†4,940.0
Total world	7,443.7	7,805.0

*Official information on U.S.S.R. production not available. †Week ending July 6.

APPROACHING 8,000,000 BARRELS DAILY

The large gains in Venezuela and Persian Gulf production are of controlling importance in postwar world operations. The two areas will be more competitive than they were prewar. Indicative of this development is the fact that negotiations are under way calling for the delivery of Saudi Arabian crude oil to Argentina refineries, and next month Gulf Oil Corp., one of the owners of the Kuwait concession, will process 100,000 bbl. of Kuwait crude oil, in a trial run, at its Philadelphia refinery.

Latin America

Latin American oil reports, during the first half of this year, have indicated several interesting developments, with the announcement of Bolivia's projected 10,000-ft. trans-Oriental Mountain pipe line a highlight in the news. The first shipment of building equipment for this line landed in Bolivia early this month, and construction is now under way. The line will be extended from Tintin to Cochabamba with a refinery to be built at the latter point.

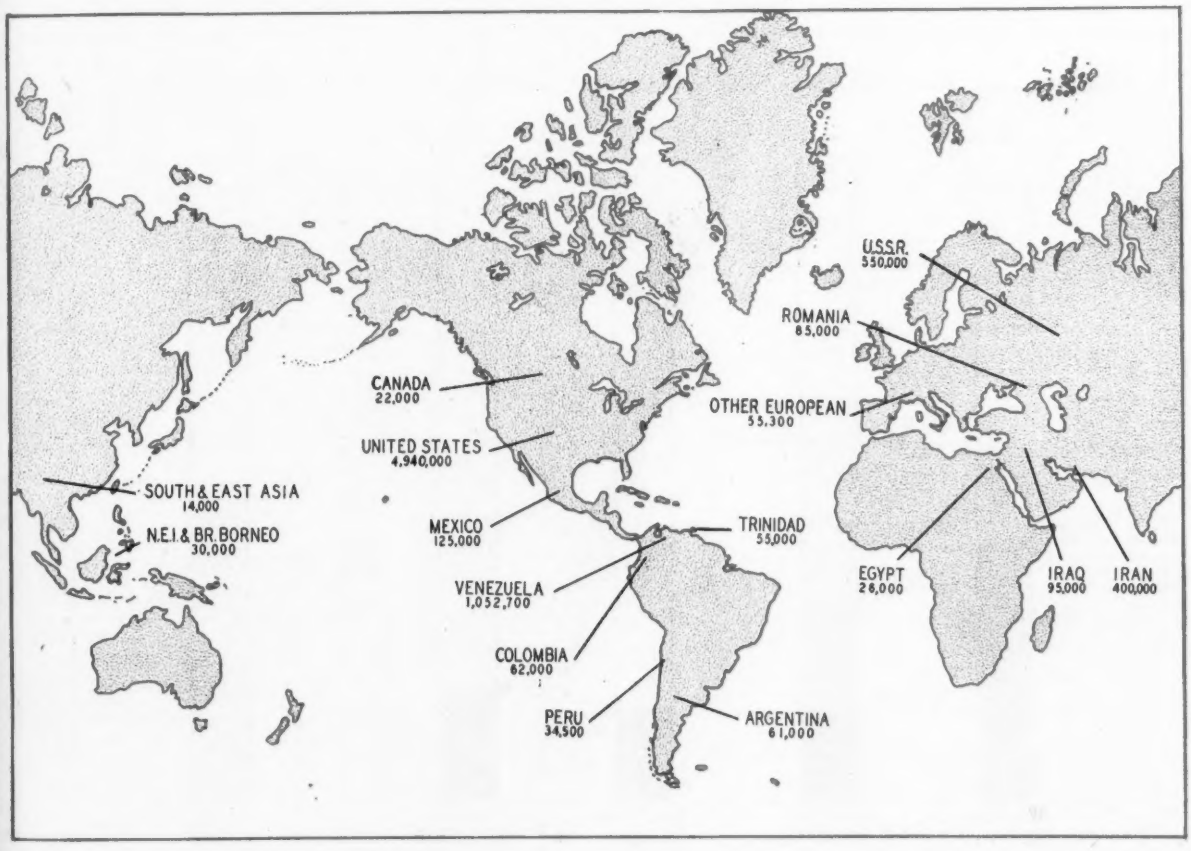
Probably the development of greatest long-range interest, in Latin America—and elsewhere for that matter—is the report that with the Peruvian Government's approval of a new oil law, private oil interests will be able economically to explore and develop the almost inaccessible Montaña region, which lies east of the Andes and where only one company (Ganso Azul) is now operating on a very small basis due to lack of transportation.

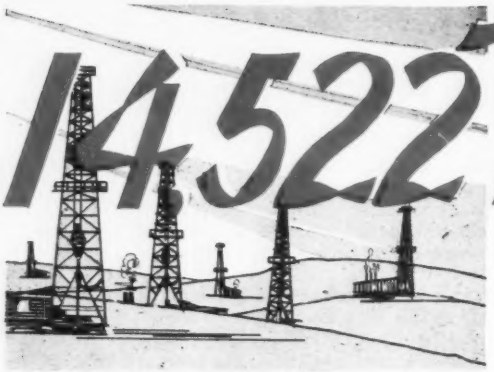
From a statement given the Journal by Y.P.F.B.'s President Lavadenz, indications are that Bolivia's congress will approve proposed oil legislation whereby foreign oil capital will be able to carry on producing operations there. While present and projected laws carry no provisions prohibiting foreign oil companies to market products in Bolivia, this is economically ruled out as Y.P.F.B. sells all petroleum products at extremely low prices.

In Chile, plans are under way to spud in the third well at the Spring Hill field, located on the Tierra del Fuego archipelago. The discovery well reportedly is capable of flowing 8,000 bbl. daily. The second well was a dry hole, but prospects are said to be excellent on the third and subsequent drillings. This is Chile's first commercial field.

Much interest is evidenced in Argentina since President Peron was elected, and while nobody is sure of how future oil conditions will shape up, it seems that there is no present danger of nationalization. Large-scale modernization plans are in progress.

Map showing production of the principal oil-producing nations of the world. Figures in barrels daily





14,522 New Wells

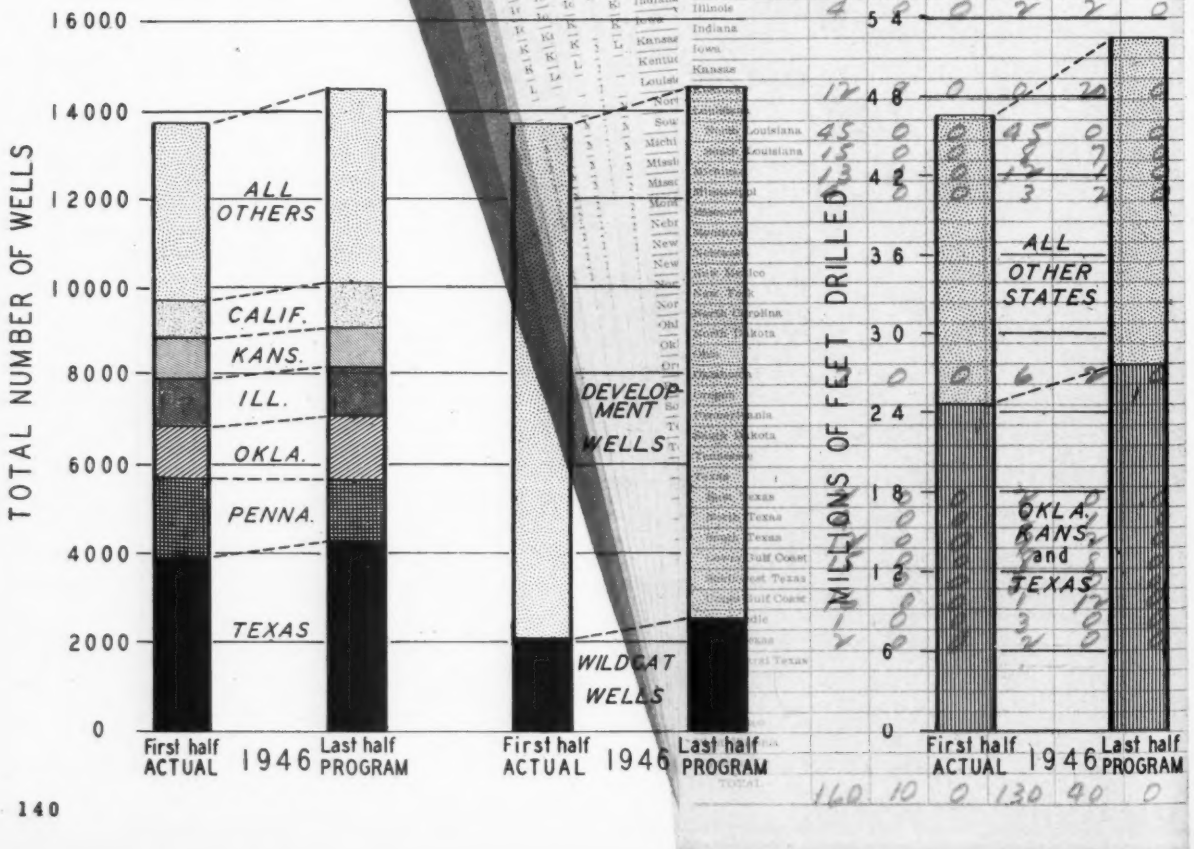
by Herndon David

THE drilling program scheduled for the last half of 1946, according to information furnished in replies to The Oil and Gas Journal's questionnaire, will make the year 1946 the greatest wildcatting year in the history of the industry, and will also establish a new high record for total footage drilled, although not a record in number of wells drilled.

The number of wildcats programed for the last half year is 2,561, approximately a 25 per cent increase over the first-half year total of 2,006. This will bring the 1946 total to 4,567 wildcats, or nearly 8 per cent higher than the previous record-breaking year, 1945, when in response to appeals from the Government during the war, the industry completed 4,256 wildcats.

However, this situation was clearly forecast in the replies to the Journal's questionnaire for the 1946 program at the beginning of the year. (See page 158, January 26, 1946), when the industry indicated a schedule of 4,442 wildcats for 1946. It appears that the unexpectedly high demand for oil is going to result only in about 3 per cent more wildcats being drilled than the industry had planned at the beginning of the year.

The obvious reasons for this have been stated repeatedly by management officials, executive geologists of the various companies, and by the economists. The industry ended the war with its normal working balances completely upset. Surface working stocks were too low for comfort, and the proven-reserve inventory ratio to annual production was out of line. Surface working stocks can be built up quickly, because this is strictly a short-term balancing operation. Rebuilding the balance between annual production and the subsurface working stocks, or the ratio of proven reserve inventory to annual production, is a



PROJECTED FOR LAST HALF OF 1946

longer-term proposition. Moreover, due to its greater size, the industry can no longer achieve this balance by being lucky enough to find a single new major field.

To meet current high demands for oil, and the still higher ones forecast by the industry's economists (who thus far have erred on the pessimistic side), the industry must build reserves. The only way to do this is to find new oil, and that means a lot of wildcatting. Geological executives of most companies, looking toward higher total production rates, worry about how to find enough new oil to maintain their individual company's competitive percentage of production. Therefore they plan more wildcats.

The one place where the unexpectedly high demand for oil in the reconversion period was quickly reflected, was in the higher-than-anticipated number of development wells completed during the first half of 1946, and the revised program for the last half. At the beginning of the year, the industry had planned on a slight breathing spell in development drilling, even though there was to be no slowdown in wildcatting.

The original schedule for 1946 called for a drop of about 16 per cent in development drilling as compared to the war year of 1945. Instead, according to the revised program, the year will end with an increase of nearly 5 per cent over 1945 in field wells. The unexpectedly high rate of the first half of 1946 will not only be maintained, but slightly exceeded. Against an actual 11,736 field wells completed in the first half, the operators have 11,961 scheduled for the last half.

A programed total footage of 52,454,000 to be drilled in the last half, will bring the year's total to 99,010,000 ft., a new high, breaking the 1941 record of 98,509,000 ft. The 1941 record was established by drilling 32,140 wells, against the scheduled 28,264 total for 1946. Thus the footage record will be broken, even though 11 per cent fewer wells will be drilled. This of course reflects the trend toward deeper drilling. Although the 1946 first-half average depth showed a reversal of this trend, the wells programed for the last half average considerably deeper, and indicate that for the entire year 1946, the normal trend toward increasing depth will continue. The high percentage of wildcats undoubtedly has an influence on this.

1946 DRILLING—FIRST HALF ACTUAL VS. LAST HALF PROGRAM

	First half actual				Last half program					
	Total wells completed	Rotary wells	Cable-tool wells	Wildcat wells	No. development wells	Thousand feet drilled	Total wells	Rotary wells	Cable-tool wells	Wildcat wells	Development wells	Total footage
Alabama	7	7	0	5	2	32	7	7	0	6	1	33
Arkansas	90	90	0	20	70	349	95	95	0	29	66	370
California	903	901	2	125	778	3,736	921	917	4	105	816	3,850
Colorado	65	65	0	11	54	416	112	112	0	18	94	710
Florida	13	13	0	12	1	90	18	18	0	16	2	145
Illinois	1,005	1,001	4	221	784	2,583	1,066	1,063	3	287	779	2,686
Indiana	253	211	42	28	225	460	260	217	43	34	226	473
Kansas	947	708	239	137	810	3,115	1,001	758	243	176	825	3,323
Kentucky	324	159	161	45	289	680	367	158	209	61	306	745
Louisiana	649	649	0	120	529	4,261	771	768	3	158	613	5,560
North	353	353	0	52	301	1,563	355	352	3	63	292	1,608
South	296	296	0	68	228	2,698	416	416	0	95	321	3,952
Michigan	356	240	126	123	233	880	437	291	146	165	272	1,044
Mississippi	124	124	0	38	86	924	168	168	0	63	105	1,302
Montana	141	113	28	25	116	299	135	111	24	32	103	287
New Mexico	183	137	46	23	160	692	211	156	55	46	165	798
New York	721	0	721	0	*721	*1,148	601	0	601	0	*601	*957
Ohio	581	0	581	32	549	1,542	678	0	678	33	645	1,801
Oklahoma	1,240	1,118	122	207	1,033	4,311	1,420	1,247	173	287	1,133	4,979
Pennsylvania	1,711	12	1,699	0	*1,711	*2,584	1,426	12	1,414	0	*1,426	*2,135
Texas	3,935	3,707	228	278	3,179	17,151	4,196	3,936	260	970	3,226	19,372
Eastern	367	309	58	56	311	2,009	325	325	0	71	254	1,139
North Central	1,420	1,283	137	286	1,134	3,623	1,408	1,268	140	302	1,106	3,854
Panhandle	173	168	5	5	168	527	167	155	12	9	158	529
West	823	725	98	109	714	4,007	952	844	108	143	809	5,020
Southwest	289	287	2	128	161	1,032	301	301	0	145	156	1,272
Gulf Coast	883	883	0	192	691	5,953	1,043	1,043	0	300	743	7,558
West Virginia	349	1	348	0	349	924	489	0	489	0	489	1,269
Wyoming	82	75	7	34	48	348	116	107	9	52	64	531
Miscellaneous	23	19	4	19	4	71	27	23	4	23	4	84
Total United States	13,742	9,344	4,398	2,006	11,736	46,566	14,522	10,164	4,358	2,561	11,961	52,454

*Includes input wells.

Completions

UPWARD TREND PROMISES TO CONTINUE REMAINDER OF YEAR

by Herndon David

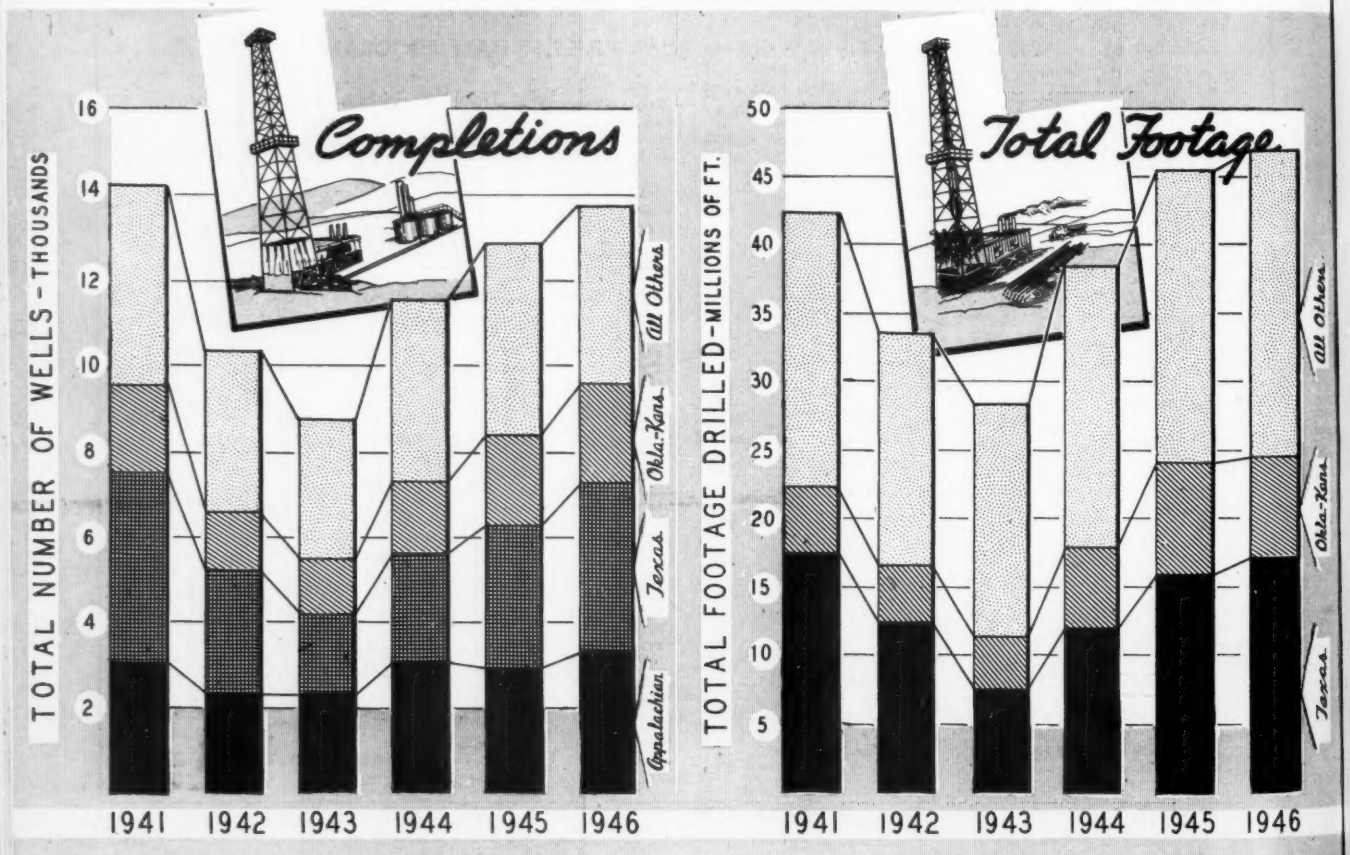
DESPITE material shortages, the number of wells completed during the first 6 months of 1946 climbed to the highest peak during any comparable period since 1941. Operators completed 13,742 wells, an increase of 7.2 per cent over the first half of 1945. Wildcatting accounted for 2,006 of the completions, a decline of 49 from the record-breaking total drilled during the same period last year, but 17.5 per cent of the wildcats were successful, compared to 16.2 per cent last year.

Among the major oil-producing states, Texas continued its lead in drilling activity with 3,955 wells completed, an increase of 11.4 per cent over last year; Oklahoma, although registering a slight decline continued in second place with 1,240 completions; Illinois, showing an increase of 26.2 per cent to bring the total completions in that state to 1,005, jumped from fifth to third place. Kansas, although showing an increase of 17.5 per cent, and a total of 947 wells, remained in fourth place, while California dropped from third to fifth place with only 903 completions, a decrease of 21.3 per cent. Louisiana, which has remained in sixth place for several years, recorded an increase of over 30 per cent, bringing the total completions to 649.

Footage Trends

One of the surprising results of the first 6 months of drilling activity was the downward trend in average depths drilled in almost every major area of the country. Although total footage drilled increased 1,191,000 ft. over first half of 1945 all states except California, Mississippi, Colorado, and Indiana showed decidedly downward trends in average footages. One

CHARTS SHOWING TREND IN FIRST HALF OF EACH YEAR



UP 7.2 PER CENT FIRST HALF

possible explanation is that in many shallow areas operators have been faced with spacing regulations during the war years, and many locations which would have been drilled in normal times were left undrilled. With the ending of drilling restrictions, operators have gone back into these areas to complete their drilling programs, and the result has been an increase in drilling activity and total footage, but a decrease in the average depths.

Texas

Texas operators, faced with unprecedented demands for crude oil during the first half of this year, completed 11.4 per cent more wells than have been completed in that state during the first 6 months of any year since 1941. The intensive wildcatting program, even though it did not reach last year's peak, reached a high degree of success with almost 17 per cent of the wildcats resulting in a discovery. Development completions showed a large increase, and accounted for more than 27 per cent of all the development wells completed in the U. S.

The fields which were the most active during the first 6 months and those which are expected to receive the most active development campaigns during the remainder of the year are as follows:

Upper Gulf Coast: Livingstone, Sour Lake, West Ganado, Fannett, North Katy.

Lower Gulf Coast: Willimar, Seeligson, Tijernia-Canales, Tom O'Connor, La Gloria.

South Texas: Aviators, North Albercas, Sejita, Agua Prieta, Rincon.

South Central: Charlotte, Imogene, Pearsall, South Campana.

West Texas: Keystone, TXL, Garza, Fullerton, Sharon Ridge. Martin pool may replace Garza during last half year.

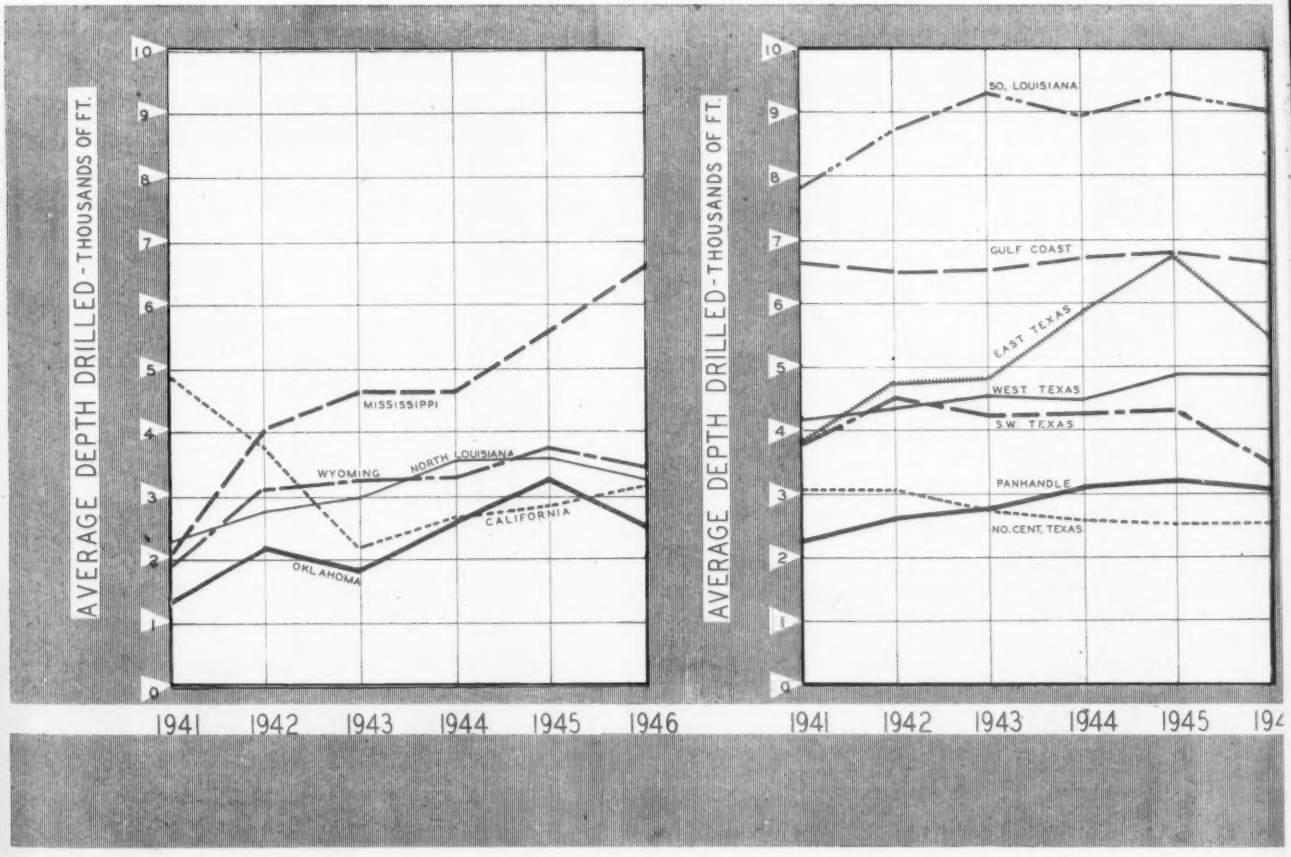
Eastern: Hawkins, Carthage, Sand Flat, East Texas, Talco. Mount Sylvan may have active campaign during last half year.

North Central: Electra, Gatewood, KMA, Holliday, Wilson. Fields with prospect of most drilling during last half are Electra, Gatewood, Holliday-Daume area, National, and Hildreth.

Southeast New Mexico: Grayburg-Jackson, Paddock, Square Lakes, Drinkard, Caprock.

The probable greatest increase in drilling in Texas during the last half of the year will be in the West Texas area. Several new pays and extensions have

CHARTS SHOWING TREND IN FIRST HALF OF EACH YEAR



WILDCAT COMPLETIONS, FIRST 6 MONTHS 1946

	Comp.	Oil	Gas	Dry
Ohio	32	2	12	18
Indiana	28	3	2	23
Illinois	221	27	6	184
Kentucky, Western	45	8	2	35
Michigan	128	9	3	116
Kansas	137	15	3	119
Neb., Mo., Iowa	5	0	0	5
Oklahoma	207	41	21	145
Texas	776	115	14	647
North Texas	286	25	1	260
West	109	24	1	84
Panhandle	5	0	0	5
Eastern	86	10	1	45
Gulf Coast	192	43	6	143
Southwest	128	13	5	110
Louisiana	120	35	3	82
Northern	52	6	0	46
Southern	68	29	3	36
Arkansas	20	3	0	17
Mississippi	39	1	1	37
Alabama	5	0	0	5
Georgia	2	0	0	2
Florida	12	0	0	12
Montana	25	10	0	15
Wyoming	34	7	3	24
Colorado	11	2	0	9
Utah	2	1	0	1
New Mexico	23	3	0	20
California	125	4	2	119
Arizona	1	0	0	1
Oregon	2	0	0	2
Tennessee	4	0	0	4
South Dakota	2	0	0	2
Washington	1	0	0	1
Total United States	2,008	288	86	1,554
First half 1945	2,059	279	84	1,721

DEVELOPMENT WELL COMPLETIONS, FIRST 6 MONTHS 1946

	Comp.	Oil	Gas	Dry
New York	721	354	8	*359
Pennsylvania	1,711	880	115	*716
West Virginia	349	33	236	80
Ohio	549	147	241	161
Indiana	225	150	14	61
Illinois	784	586	1	*197
Kentucky	289	150	50	72
Michigan	236	115	24	97
Kansas	810	504	112	194
Neb., Mo., Iowa	3	3	0	0
Oklahoma	1,033	649	109	*275
Texas	3,179	2,294	227	*658
North Central	1,134	714	16	*402
West	714	634	8	86
Panhandle	188	77	68	23
Eastern	311	219	64	28
Gulf Coast	681	527	67	107
Southwest	191	103	12	46
Louisiana	529	363	50	116
Northern	301	201	46	54
Southern	228	162	4	62
Arkansas	70	56	0	14
Mississipi	86	78	1	8
Alabama	2	2	0	0
Georgia	0	0	0	0
Florida	1	1	0	0
Montana	116	68	22	26
Wyoming	49	41	3	4
Colorado	54	52	1	1
New Mexico	186	122	15	23
California	779	700	32	46
South Dakota	1	0	1	0
Total United States	11,726	7,373	1,236	3,086

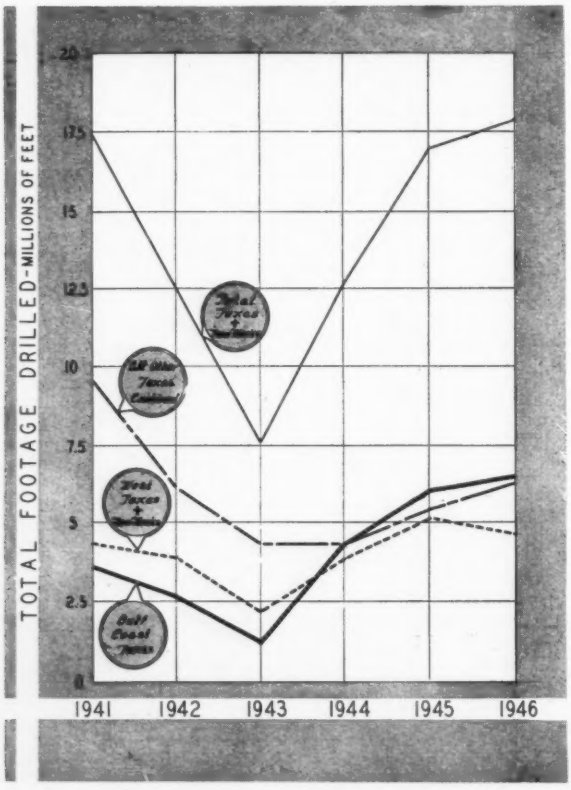
*Includes input wells.

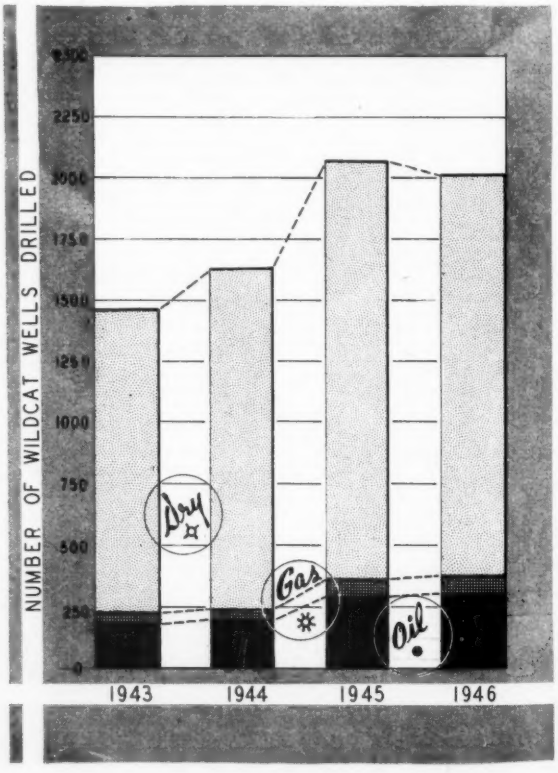
been discovered for the fields listed above, but these are deep and their development has been slowed by the shortages of pipe and drilling materials so far.

Louisiana

Louisiana showed a greater percentage increase in drilling during the half year than any other state except Colorado. North Louisiana was responsible

CHARTS SHOWING TREND IN FIRST HALF OF EACH YEAR





and overcame a slight decrease in the southern part.

The fields in the northern section which provided the most activity, and which are likely to continue in the lead during the remainder of the year, are Big Creek, Delhi, Caddo, Lake St. John, and Haynesville.

Deeper drilling was the theme in South Louisiana development and this trend probably accounted for the decrease in number of completions. Fields responsible for the greatest amount of activity were Egan, Vinton, Bayou Sale, Delta Farms, and Good Hope. Two of the new discoveries of 1946, Mamou in Evangeline Parish and Bon Air in Jefferson Davis Parish, are now undergoing intensive development and during the last half may replace some of the leaders of the first half.

Oklahoma-Kansas

Although Kansas showed an increase and Oklahoma showed a slight decrease in drilling activity during the first 6 months, trends in both states were about the same. Concentration of development was in shallow areas with fairly extensive wildcatting programs underway in both deep and shallow areas.

In Oklahoma the Greater Seminole district of Hughes, Seminole, and Pottawatomie counties was representative of the shallow pays. The West Edmond field led throughout the 6 months of drilling, but a large-scale townsite drilling program at Cement brought that field into second place in total completions. Other active areas were the Velma pools, and the Cheyarha and Davenport fields.

These fields, with the exception of West Edmond and Cement, will probably continue to be among the most active during the coming 6 months. In addition, three recent Cotton County discoveries are now in the throes of a fast play and intensive development may be expected here.

In Kansas the Hugoton gas field accounted for the most activity, and was closely followed by the Trapp field. The next three most active areas were the Kraft-Prusa, El Dorado, and Stoltenberg. No large shift in activity is seen for the next 6 months.

Illinois

Illinois operators completed more wells than during any comparable period for the past 5 years. Much of the increase in drilling was in the Mattoon pool, where 220 producing wells were completed. Drilling in Mattoon has now decreased to about one-half of the high of January, but still leads the state. Other especially active pools were Ingraham West, Keenville, Clay City Consolidated, Herald, and Stokes-Brownsville.

Although Mattoon drilling has leveled off there are no signs of a drastic decrease, and it will probably continue to lead the rest of the year. Unless some new prolific pool is found, the other fields which have shown the greatest activity so far this year will probably continue to account for the majority of drilling outside Mattoon.

Rocky Mountains

The only intensive drilling campaign in the Rocky Mountain area was in the Rangely field in western Colorado where 51 wells were completed with only one dry hole. Development during the last half of 1946 is expected to exceed that of the first half, as approximately 10 additional rigs will be working.

Wyoming had no outstanding field, the rule being from one to three rigs running in each field. The most active fields were East Lance Creek, Big Muddy, Lance Creek, and Little Buffalo Basin. Most older fields are about drilled up, but it is anticipated that there will be more drilling in Hamilton, Big Sand Draw and in the fields of Carbon and Sweetwater counties during the last half.

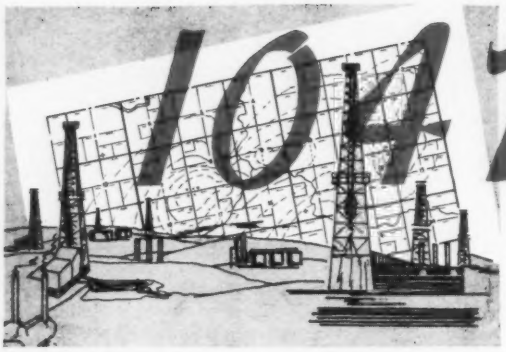
Montana led the Rocky Mountain area with 141 completions. Kevin-Sunburst was the most active field with 34 completions, Cut Bank second with 33 and Cat Creek third with 24. The indications are that the program will call for more wells in the last half of the year, especially in Cut Bank.

California

Wilmington headed the completion list in California during the first half of 1946 and will probably remain at the head for the remainder of the year. South Belridge ranked second, while Edison was third. Cymric and Newport ranked fourth and fifth. The outlook for the last half of 1946 is for continuance of drilling at about present levels. Reductions in Edison, Cymric and other fields will probably be offset by increases at Wilmington. Additional drilling will also be undertaken in Newport-Huntington Beach area.

SUMMARY OF COMPLETED WELLS, FIRST 6 MONTHS 1946

	Total comp.	Oil	Gas	Dry	Service	Avg. footage	Total Jan.-June 1945
New York	721	354	8	6	353	1,592	662
Pennsylvania	1,711	890	115	42	664	1,510	1,730
West Virginia	349	33	258	58	0	2,648	389
Ohio	581	149	253	179	0	2,653	431
Indiana	253	153	16	84	0	1,820	140
Illinois	1,005	623	1	379	2	2,520	742
Kentucky	334	166	61	107	0	2,037	298
Michigan	366	124	29	213	0	2,404	363
Kansas	947	519	115	313	0	3,290	806
Neb., Mo., Iowa	8	3	0	5	0	2,351	14
Oklahoma	1,240	689	130	414	7	3,477	1,272
Texas	3,955	2,409	241	1,302	3	4,337	3,551
North Central	1,420	739	19	659	3	2,551	1,054
West	823	678	9	136	0	4,869	931
Panhandle	173	77	68	28	0	3,049	268
Eastern	367	229	65	73	0	5,475	156
Gulf Coast	833	570	63	250	0	6,742	811
Southwest	289	116	17	156	0	3,571	331
Louisiana	649	398	53	198	0	6,565	499
Northern	353	207	46	100	0	4,429	174
Southern	296	191	7	98	0	9,113	325
Arkansas	90	59	0	31	0	3,873	84
Mississippi	124	77	2	45	0	7,450	184
Alabama	7	2	0	5	0	4,531	13
Georgia	2	0	0	2	0	4,221	3
Florida	13	1	0	12	0	6,914	9
Montana	141	78	22	41	0	2,119	151
Wyoming	82	48	6	28	0	4,244	89
Colorado	65	54	1	10	0	6,402	17
Utah	2	1	0	1	0	1,398	0
New Mexico	183	125	15	43	0	3,783	222
California	903	704	34	165	0	4,159	1,147
Arizona	1	0	0	1	0	4,300	0
Oregon	2	0	0	2	0	8,574	0
Tennessee	4	0	0	4	0	1,380	1
South Dakota	3	0	1	2	0	2,473	1
Washington	1	0	0	1	0	6,230	2
Total 1946	13,742	7,659	1,361	3,693	1,029	3,389	12,820
Total 1945	12,820	6,908	1,319	3,512	1,082	3,538	.....
Difference	922	751	43	181	53	.....	.....



104 Major Fields

by Charles J. Deegan

IN the old, but not-so-good days before conservation laws, a major field was defined as one that reached a peak production of 100,000 bbl. per day or more. With the advent of a better understanding of the laws of reservoir energy, high flush-production rates became the exception. Therefore any compilation of major fields which includes both old and new, to permit studies of their influence in the industry, must be based on a new definition which will apply to new and old alike. For this reason we have adopted ultimate recovery as the yardstick, and 100 million barrels ultimate as the dividing line between major and nonmajor fields.

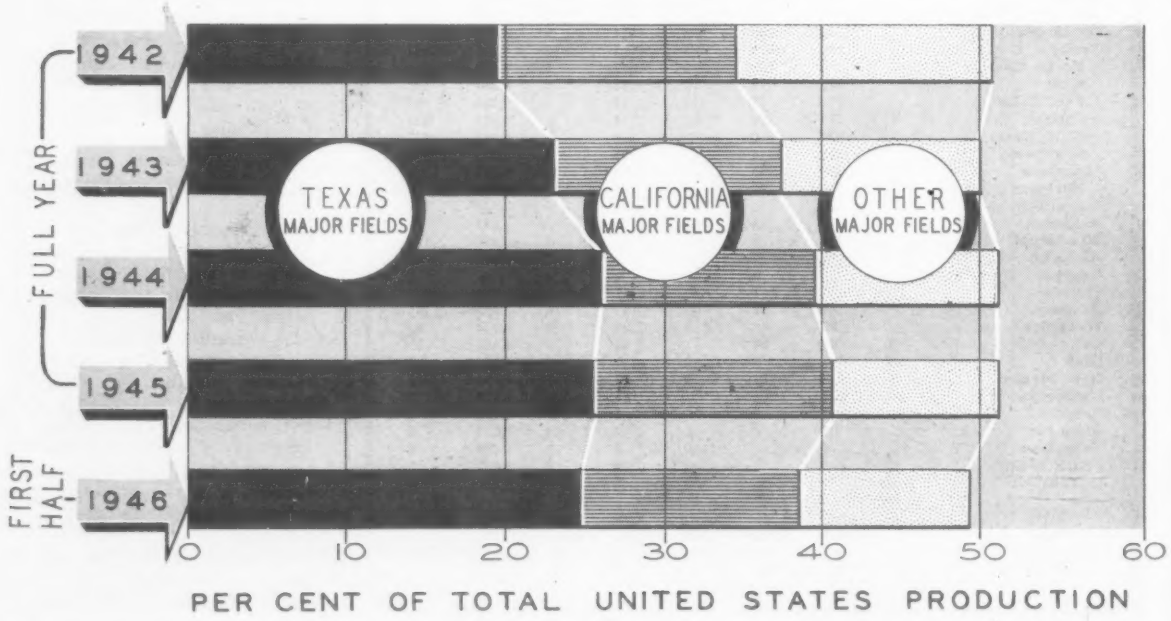
There are thousands of oil fields, some estimate around 15,000. The data show that 104 of these can be classed as major fields. This small fraction of the total has accounted for 54.34 per cent of the total oil produced in the United States to date; had 58.06 per cent of the proven reserves at the end of 1945; and supplied just about 50 per cent of the oil which won the war.

Incidentally these figures indicate there is substantial merit in the belief common to many executives, that practically all of the profit made by the industry comes from the major fields. They say that on net balance, all other fields probably do well to break even, exploration and overhead costs considered.

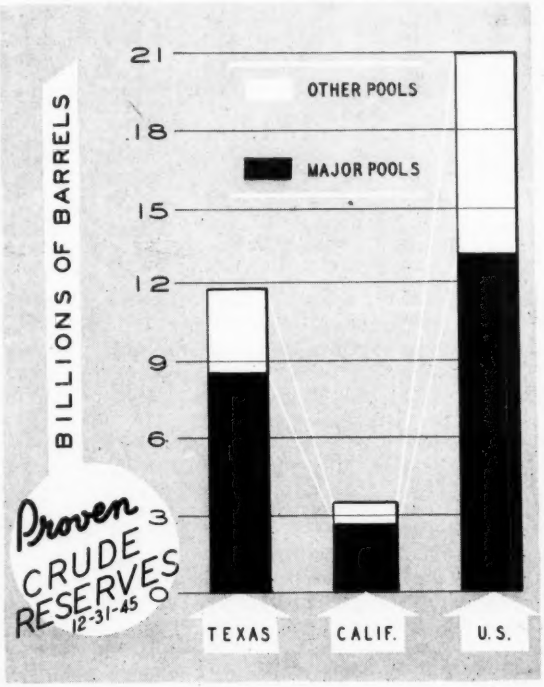
For those who wish to compare reservoir data; comparative recoveries per acre foot of pay; development rates and their influence on costs and recoveries; geological environments and their influence on accumulation and recovery; or the factors of time and geological exploration techniques on the incidence rate of finding major fields; these data offer a beginning point.

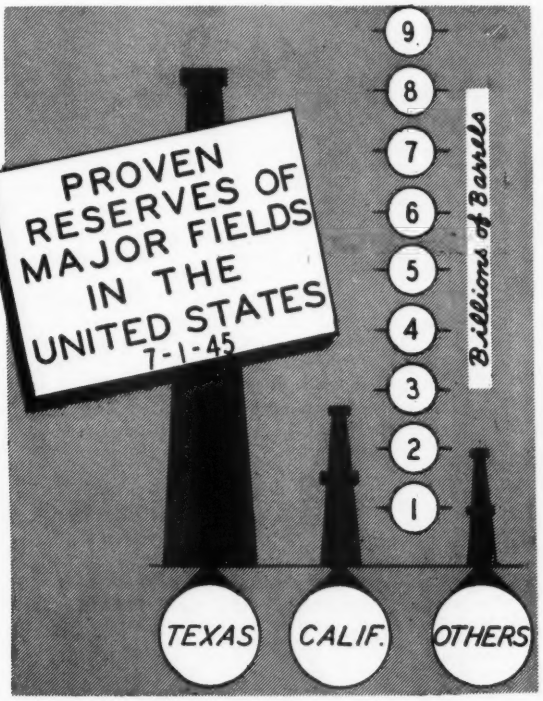
Two states, Texas and California, account for the bulk of the major fields. The big fields of these two states combined have produced 11,931,000,000 bbl. up to July 1, 1946, out of a total for all the big fields in the United States of 17,571,000,000 bbl. The proven reserves of the big fields of these two states account for 10,905,000,000 bbl., out of a total U. S. major-field proven area of 12,654,000,000 bbl.

Since Texas dominates the country in production and proven reserves, it is not surprising that it dominates the list of major fields. Its big fields alone supplied nearly one-fifth of the nation's oil production during the war years. That they are still comparatively youthful is shown by the fact that as of July 1, 1946, the Texas major fields had produced only 32.5 per cent of the total accumulated production of all big fields, but possessed 65.8 per cent of the proven reserves of such fields. In fact as of December 31, 1945, of the total proven reserves of the United States, 40.5 per cent was accounted for by the major fields of this one state.



YIELD 54.34 PER CENT OF NATION'S OIL





PRODUCTION AND RESERVES OF 104 U. S. MAJOR FIELDS*

(In thousands of barrels)

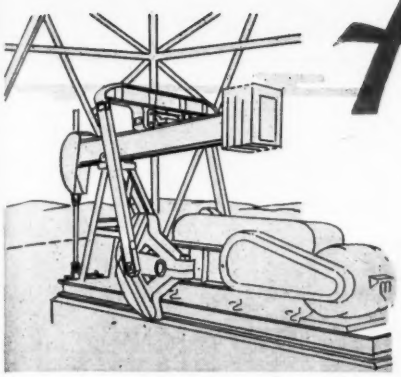
State and field—	Est. ultimate production	Remaining reserve, 7-1-46	Cumulative prod. to 7-1-46	Prod. first half 1946	Prod. full year 1945	Prod. full year 1944	Prod. full year 1943	Prod. full year 1942
CALIFORNIA:								
Buena Vista	420,000	97,356	322,644	7,258	15,579	6,888	5,278	5,296
Coalinga, East	325,000	71,981	253,019	3,190	7,563	8,001	7,069	5,234
Coalinga, Nose	380,000	271,581	108,419	10,033	21,096	20,772	17,977	8,465
Coalinga, West	185,000	27,496	157,504	1,273	2,890	2,657	2,216	2,102
Coles Levee, North	100,000	71,611	28,389	2,743	6,008	5,770	4,790	3,978
Elk Hills	435,000	241,714	193,286	2,230	15,813	7,722	5,373	4,363
Kern Front	105,000	38,263	66,737	2,286	4,686	3,195	2,663	2,409
Kern River	330,000	33,922	296,078	1,798	3,547	3,478	3,095	2,667
Kettleman North Dome	440,000	122,986	317,014	6,954	14,349	15,135	15,290	13,018
McKittrick-Cymric	120,000	18,004	101,996	2,008	2,017	1,793	1,712	1,782
Midway-Sunset	820,000	122,866	697,134	6,835	14,373	15,120	14,929	15,108
Mount Poso	155,000	65,791	89,209	3,109	6,726	7,951	8,350	8,008
Rio Bravo	100,000	64,071	35,929	2,456	5,732	5,920	5,443	3,575
Santa Maria	230,000	69,607	160,393	2,407	5,057	4,879	3,081	2,742
Santa Maria Valley	170,000	100,815	69,185	6,199	13,538	11,281	8,268	7,523
Ventura Avenue	510 000	198,447	311,553	8,402	17,663	17,487	15,489	13,652
Brea Olinda	220,000	41,219	178,781	1,922	4,194	4,720	4,248	3,705
Coyote, West	195 000	47,771	147,229	2,810	5,266	4,433	4,421	3,783
Dominguez	235,000	69,957	165,043	3,031	6,722	7,872	9,123	7,920
Huntington Beach	530 000	159,903	370,097	8,480	17,558	17,141	13,217	11,980
Inglewood	200,000	45,999	154,001	2,429	5,840	6,460	6,909	6,742
Long Beach	800,000	82,900	717,100	4,634	9,803	10,792	11,552	12,978
Montebello	175,000	30,427	144,573	1,626	3,658	3,904	3,964	3,925
Richfield	130 000	22,221	107,779	1,359	2,725	2,411	2,517	2,751
Santa Fe Springs	565,000	59,100	505,900	3,060	6,258	6,831	7,303	7,756
Seal Beach	140,000	36,155	103,845	1,799	3,425	2,566	2,586	2,695
Torrance	150,000	31,318	118,682	1,589	3,244	3,180	2,832	2,993
Wilmington	630,000	329,971	300,029	18,581	36,222	36,765	34,360	33,447
ROCKY MOUNTAIN AREA:								
Cut Bank	100 000	50,463	49,537	2,289	4,907	5,443	5,327	5,513
Elk Basin	200,000	176,307	23,693	2,459	3,990	3,500	2,596	204
Lance Creek	115,000	44,308	70,692	2,453	5,463	6,535	7,274	8,605
Oregon Basin	155,000	118,885	36,115	2,006	4,394	4,392	4,981	7,127
Rangely	165,000	158,469	6,531	3,037	1,495	392	321	307
Salt Creek	380,000	60,338	319,662	2,321	4,499	4,772	4,789	4,954

(Continued on next page)

PRODUCTION AND RESERVES OF 104 U. S. MAJOR FIELDS* (Continued)

State and field—	Est. ultimate production	Remaining reserve, 7-1-46	Cumulative prod. to 7-1-46	Prod. first half 1946	Prod. full year 1945	Prod. full year 1944	Prod. full year 1943	Prod. full year 1942
OKLAHOMA:								
Avant	105,000	7,630	97,370	371	750	789	877	833
Bowlegs	135,000	8,899	126,101	601	1,250	1,517	1,714	1,889
Burbank	320,000	58,474	261,526	2,470	5,498	5,581	5,890	6,102
Cushing	400,000	27,463	372,537	1,381	2,814	2,925	2,895	3,054
Earlsboro	200,000	11,450	188,550	804	1,737	2,502	2,057	2,699
Fitts	115,000	10,190	104,810	810	1,701	2,167	3,477	4,218
Glennpool	250,000	20,505	229,495	1,188	2,359	2,135	1,740	1,468
Healdton	225,000	22,891	202,109	1,191	2,423	2,509	2,614	2,817
Hewitt and West	110,000	6,856	103,144	846	2,055	2,040	2,368	5,162
Little River	145,000	7,358	137,642	718	1,492	1,746	1,935	2,338
Oklahoma City	700,000	62,733	637,267	5,385	12,968	16,235	15,241	31,293
St. Louis district	180,000	10,434	169,566	791	1,775	2,593	3,615	6,349
Seminole	175,000	13,725	161,275	971	1,990	2,241	2,534	2,879
Tonkawa	130,000	6,534	123,466	207	385	411	503	593
West Edmond	180,000	130,992	49,008	14,255	26,548	7,606	474	0
KANSAS:								
El Dorado	225,000	31,247	193,753	1,303	2,628	2,530	2,433	2,529
Silica	105,000	35,587	69,413	2,425	5,868	7,215	8,890	8,167
Trapp	135,000	63,767	71,233	5,303	10,631	9,183	10,895	9,759
ARKANSAS:								
Magnolia	100,000	56,360	43,640	2,370	4,963	5,591	6,001	6,366
Smackover	450,000	41,296	408,704	1,954	4,130	4,262	4,458	4,893
LOUISIANA:								
Erath	100,000	85,557	14,443	3,440	6,318	4,184	228	197
Haynesville	135,000	45,244	89,756	1,685	3,156	4,329	5,537	4,642
Jennings	110,000	19,505	90,495	1,073	2,443	2,871	3,437	4,408
Rodessa	180,000	29,408	150,592	1,823	4,169	4,886	5,872	7,554
MISSISSIPPI:								
Tinsley	125,000	34,762	90,238	4,045	9,345	11,803	17,264	28,177
ILLINOIS:								
Bridgeport	255,000	19,919	235,081	1,068	2,144	1,932	1,880	2,027
Louden	165,000	38,713	126,287	4,217	9,463	12,870	14,443	20,407
Robinson	165,000	12,281	152,719	561	1,095	1,078	1,273	1,391
Salem	220,000	25,939	194,061	2,986	6,637	9,312	11,912	16,872
NEW MEXICO:								
Eunice	150,000	70,137	79,863	2,720	5,707	6,393	6,464	5,218
Hobbs	150,000	35,570	114,430	1,730	3,874	4,101	3,798	2,973
Monument	165,000	87,783	77,217	3,290	7,139	7,516	7,235	5,729
EASTERN TEXAS:								
East Texas field	5,000,000	2,711,695	2,288,305	61,801	131,210	134,768	128,568	120,681
Hawkins	205,000	151,449	53,551	6,885	12,210	13,318	14,224	5,445
Mexia	105,000	4,867	100,133	237	491	501	514	562
Powell	120,000	6,595	113,405	227	454	475	508	554
Talco	165,000	76,892	88,108	4,303	8,284	8,673	9,220	9,505
Van	450,000	283,086	166,914	5,317	10,494	11,636	6,215	3,404
NORTH TEXAS:								
K.M.A.	150,000	70,348	79,652	4,174	8,309	9,546	10,784	11,236
SOUTH TEXAS:								
Luling	105,000	20,917	84,083	724	1,563	1,772	1,650	1,549
WEST TEXAS:								
Big Lake	115,000	11,544	103,456	657	1,407	1,535	1,191	1,289
Cowden, North and Deep	165,000	112,862	52,138	4,924	9,997	9,164	4,051	3,018
Goldsmith	245,000	176,801	68,199	4,598	8,381	8,641	7,353	6,503
Hendricks	225,000	14,580	210,420	708	1,555	1,738	2,073	2,512
Howard-Glasscock	175,000	53,637	121,363	2,486	4,948	4,817	4,832	4,814
Keystone	360,000	332,841	27,159	6,961	6,535	2,453	1,743	1,703
McCamey	110,000	44,250	65,750	1,617	3,199	3,301	3,190	3,197
McElroy	250,000	90,738	159,262	4,951	10,717	10,416	6,148	4,909
Seminole	130,000	101,192	28,808	3,745	8,088	8,777	2,840	1,431
Slaughter	480,000	396,625	83,375	11,076	23,440	23,081	11,241	7,680
Ward, North and Estes	100,000	45,390	54,610	2,328	4,622	4,811	3,720	3,486
Wasson	580,000	469,069	110,931	8,771	23,256	23,852	12,420	9,559
Yates	640,000	332,404	307,596	6,716	13,053	12,639	8,677	6,640
TEXAS GULF COAST:								
Agua Dulce	125,000	107,934	17,066	1,889	7,608	3,466	1,834	732
Anahuac	275,000	214,657	60,343	4,965	10,923	11,885	8,902	3,588
Barbers Hill	110,000	25,763	84,237	922	1,927	2,066	2,343	2,862
Conroe	700,000	484,011	215,989	9,834	20,992	23,192	19,957	13,508
Hastings	375,000	259,580	115,420	9,125	20,608	22,167	18,004	10,432
Hull	115,000	13,289	101,711	658	1,489	1,631	1,886	2,238
Humble	140,000	9,631	130,369	389	821	801	797	840
Katy, North	130,000	128,998	1,002	286	467	194	55	0
Old Ocean	200,000	161,756	38,244	3,398	5,936	5,516	4,831	3,728
Seeligson	400,000	371,894	28,106	7,032	11,384	7,440	1,530	257
Spindletop	130,000	1,881	128,119	112	273	341	373	419
Thompson	275,000	183,872	91,128	6,078	12,749	13,549	10,026	5,390
Tom O'Connor	450,000	360,248	89,752	6,649	17,676	18,744	12,690	6,915
Webster (Friendswood)	350,000	276,262	73,738	8,938	19,820	20,902	11,457	3,620
West Columbia	125,000	26,098	98,902	353	2,626	2,584	2,050	1,990
West Ranch	235,000	198,536	36,464	3,324	7,127	8,130	6,826	5,243
Total major fields	30,225,000	12,653,623	17,571,377	416,206	876,194	861,733	754,109	701,749
Total United States			32,336,298	846,538	1,711,103	1,677,753	1,505,613	1,386,645
Per cent U. S. total			54.34	49.17	51.21	51.36	50.09	50.61
Per cent U. S. reserves 12-31-45		58.06						

*Fields with estimated ultimate production of 100,000,000 bbl. or over.



Pumping Forecast

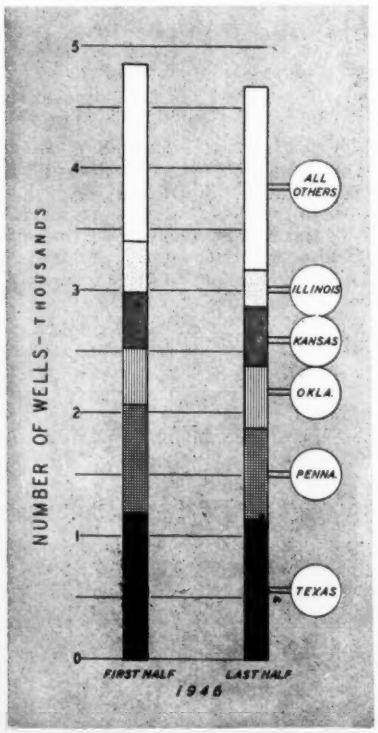
NEARLY 5,000 wells will go on the pump or other form of artificial lift in the last half of 1946, replies to The Oil and Gas Journal's questionnaire indicate. This is only a slight decrease from the 4,854 wells put on artificial lift during the first half year. These totals are less than indicated in the January survey, but there appear to be some intangible items that make the situation more fluid than ordinarily.

The coal and steel strikes of the first half year resulted in some uncertainty, and undoubtedly delays in delivery of equipment in some instances. It is difficult to gage what importance this plays in estimates of replacements for the last half, but undoubtedly whatever weight it has, is on the conservative side. It is possible, therefore, that the estimates for the last half may prove to be unduly pessimistic.

Another influence on the last-half estimates, particularly among the smaller operators, is the fate of price control and production subsidies. This, too, probably weighs on the conservative side, considering the unsettled prospects at the time the questionnaire replies were formulated. If the price controls are eliminated, and as is very likely in such event, the price of crude oil advances another 25 cents per barrel, the number of new pumping units required will undoubtedly increase rather sharply over the estimates for the last half.

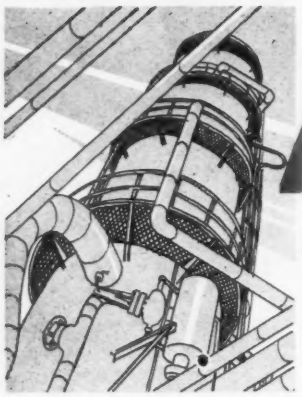
If price controls are maintained, and the stripper-well subsidy is also continued, replacement of old and obsolete units will undoubtedly go higher than the estimates made in reply to the questionnaire. This will probably hold true, even in the face of increased cost of new equipment, necessitated by higher basic steel and fabricators' prices.

The continuation of crude production at or near record-breaking rates throughout the last half of 1946 is assured by the supply-and-demand situation. This means that the breathing spell anticipated for the reconversion period has been much shorter than anticipated. Therefore, there has been less time for overhaul and repairs than probably originally planned by many companies. The result of this will be that for lack of labor and time, there will be an increase in the amount of marginal equipment that will be junked and replaced, instead of being repaired and transferred to less-strenuous operation requirements.



THE OIL AND GAS JOURNAL PUMPING SURVEY

State or district—	Wells put on pump first half 1946	Wells likely to go on pump last half 1946	No. artificial lift units needed last half 1945	Estimated replacement costs obsolete pumping units
Alabama	2	1	1	$2,000
Arkansas	24	19	35	64,750
California	233	244	227	419,950
Colorado	0	1	1	4,000
Illinois	416	313	160	296,000
Indiana	141	137	78	144,300
Kansas	450	479	421	778,850
Kentucky	142	156	102	142,800
Louisiana	113	153	145	373,200
North	63	88	84	159,700
South	50	65	61	213,500
Michigan	62	79	60	111,000
Mississippi	38	19	34	102,000
Montana	70	56	56	81,000
New Mexico	94	96	88	162,800
New York	354	303	111	132,200
Ohio	149	182	161	201,250
Oklahoma	459	504	334	617,900
Pennsylvania	890	759	648	1,198,800
Texas	1,178	1,123	864	1,802,300
Eastern	222	265	155	348,750
North Central	578	448	359	664,150
Panhandle	70	71	59	111,000
West	171	196	187	420,750
Southwest	25	24	31	64,600
Gulf Coast	112	119	73	193,050
West Virginia	33	33	18	32,350
Wyoming	6	9	7	16,600
Total United States	4,854	4,666	3,551	$8,684,750



Refining

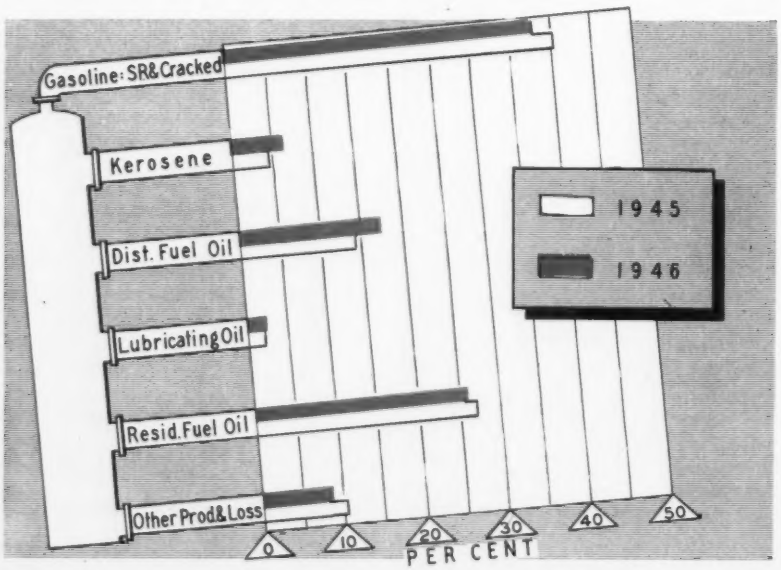
ALL OPERATING DIVISIONS EXPAND FROM PREWAR LEVELS

NEW records in the manufacturing phases of the petroleum industry were established the first 6 months of 1946 and it is certain that the plant output of the first half-year will be exceeded over the remainder of the year. In the United States the crude runs to stills of 411 operating refineries slightly exceeded the runs for the same period last year, according to the weekly estimates (not revised) of American Petroleum Institute. Based on those estimates the crude-oil charge to stills the first half-year exceeded the same period in 1941 by 35 per cent. Bureau of Mines reports for the full half-year are not available but the government data showed a 27 per cent increase over 1941 for the first 3 months of this year.

Operations of the 483 natural-gasoline plants and 41 cycling plants paralleled the trend in refinery activities closely. The Bureau of Mines report covering operations through April revealed that the output of natural gasoline, cycle products, and liquefied products for the 4 months averaged 311,000 bbl. daily, which compares with 309,000 bbl. daily for the same period in 1945.

While detailed data are not available it is certain that refinery operations outside the United States the first 6 months of this year exceeded any similar period. Foreign refineries which were not damaged during the war have generally been operated at capacity since the first of the year, their crude runs to stills in some instances exceeding the peak of the war period. The capacities of a few plants were being expanded during the latter part of the war period, and their peacetime operations now exceed the war levels. The largest new refinery is that of Arabian American Oil Co., at Ras Tanura, Saudi Arabia, now operating on a basis of 85,000 bbl. daily.

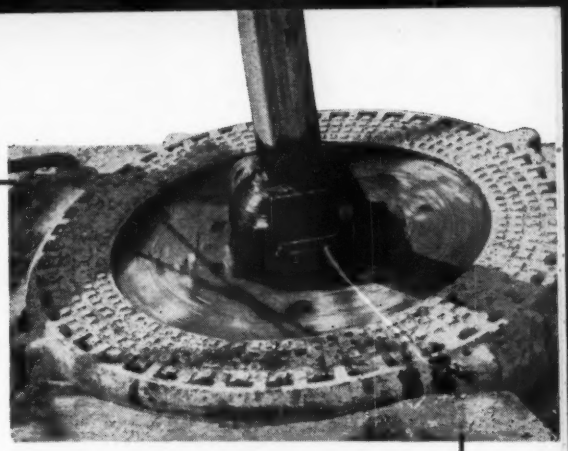
Chart showing changes in yields of products at United States refineries in 1945 and 1946



The rehabilitation of refineries in enemy and enemy-occupied countries has been slow in getting under way due to political, manpower, and equipment conditions and the output of the operating plants was a small factor in the world supply of petroleum products the first half-year. It is anticipated that this reconstruction work will be speeded up over the remainder of the year.

As shown in an accompanying chart an outstanding development of the postwar period in this country so far has been the emphasis placed on larger yields of intermediate products rather than gasoline. The demands for residual fuels have also been exceptionally strong.

by Kenneth B. Barnes



ENGINEERING ACTIVITY IS AT HIGH PEAK—IN DRILLING, COMPLETIONS, AND PRODUCTION

THE recent record shows an astounding group of accomplishments in engineering phases of drilling and production work. This applies equally as to the scores made "in the field" and to those "in the laboratory" or on the theoretical side.

World War 2 was responsible for this situation. From 1942 through 1945, many engineering improvements in drilling and in production were made. These new activities and the results from four hard-worked years are just lately coming into wider notice and appreciation, and deserve careful study on their own standpoints. They also merit scrutiny for possible application to different fields, to different types of operations, and to different economic setups.

But the war-born side, in drilling and in production, is only part of the picture in taking stock of the situation at this time. The war has been over for nearly a year. Now at this mid-year point the trek is fairly well started into that widely heralded era —"the postwar period."

Much has been made—by manufacturers, oil and gas operators, the engineers, the operating personnel—of the fact that new materials, new methods, and better and more imaginative engineering would create many further gains in drilling for and producing oil and gas. So there is that side, coupled with what was done during the war itself.

The question, or questions, of course, are—How much are drilling and production engineering improving, and, specifically, just what is it that has happened recently in these subjects? Given hereinafter are some of the high spots, not only as to the "what" but also as to the "where" and "by whom."

Drilling

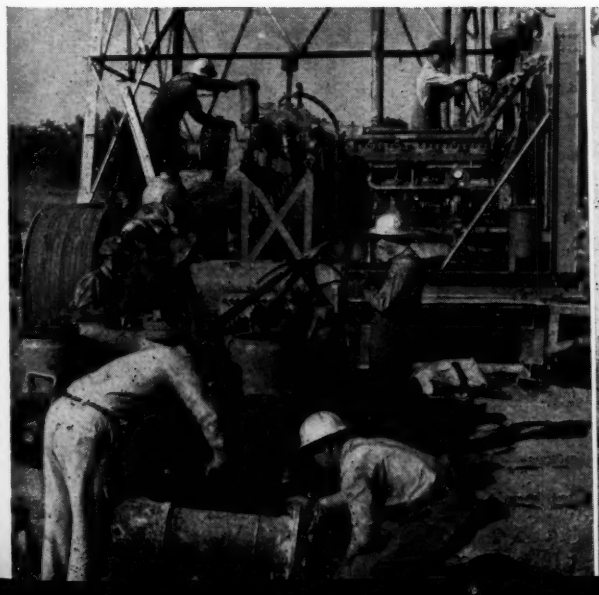
Leading off on the matter of drilling is the technology involved in cutting holes to explore the vast, hitherto virtually untested prospects lying at depths of 12,000, 15,000, and 18,000 or more feet. These prospects total millions upon millions of acres; however, the rigs to be used must be of types that can handle such depths just as efficiently as the rigs which today drill 6,000 to 10,000-ft. wells on a production-line basis. The big rigs in the deep drilling are a "must" because otherwise costs would be prohibitive. As to present practice—

In West Texas, the TXL field, Trinity Drilling Co., is operating a new "big rig" capable of going to 20,000 ft. in that area (Journal, Feb. 16, 1946). Three six-cylinder 375-hp. engines running at 800 r.p.m. supply the power. There are twin inlet and exhaust valves to each cylinder. The units set on the ground and the drive is stair-stepped up through the selective transmission to the draw works. This type of rig is well powered for such deeper work and the performance will count as a distinctly profitable item.

Over in Crane County, M. J. Delaney Co. is using a new large outfit—three engines, total 975 hp. at

(Continued on page 157)

Rigging Up for the Next One . . "Old Steady" Gets Checked



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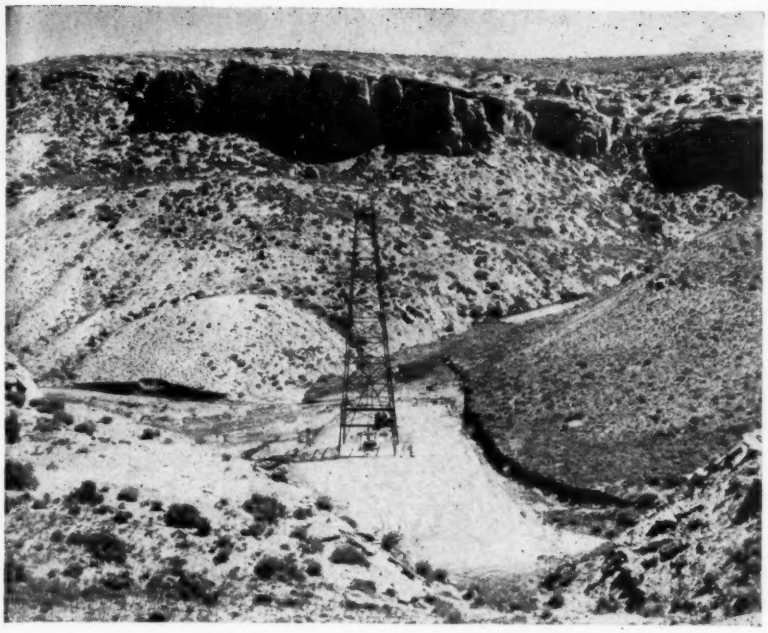
But . . . this testing is not a simple matter of miles per gallon. Complex testing devices and recording equipment, conceived and designed by Universal engineers, read the very thoughts of the motor as it hums along at high and low speeds. Every possible road driving condition is simulated. Every possible analysis and reading is made. And, when the results are studied and analyzed a report is made which tells exactly what, if anything, is wrong with the fuel and what steps should be taken to correct it.

Knowing how fuels behave . . . how they stand up under varying conditions . . . how they may be improved . . . is vitally important to every refiner. This service provides the answer . . . and it's available to every UOP licensee, large or small. It is, we believe, ample evidence of the active interest we maintain in the successful operation of the refineries we serve.



Latest big unitization project in 1946 is the rich Elk Basin (Wyoming) pool. This is one of the flowing wells in the Tensleep sand

900 r.p.m. (Journal, May 11, 1946). Pneumatic controls for the different operating units, together with control levers and instruments centralized at a special drillers' panel, provide precise operations in hoisting, drilling, and all other work, with no unprofitable lost motion or delay. Yet for portability, the draw works and transmissions, with core reel, compact into one truck load 21½ by 9½ by 8⅓ ft.

Another new-type rig has a multi-speed compounding and transmission unit that gives high flexibility between rotary table and pumps (Journal, June 15, 1946). First unit was bought by Thompson-Carr, Inc., of Houston for use in the Martin pool, West Texas. Three 350-hp. V-type 12-cylinder engines are used; main pump is of the triplex type. For a given engine speed, there are nine hoisting speeds, nine rotary speeds, nine sand-reel speeds, and nine reverse speeds. And pump speed is not linked at one ratio to rotary table speed.

But big rotary mechanical equipment units are not the only new developments in this line. Even taller derricks than the unusual are being tried. Shell Oil Co., Inc., is using a 203-ft. derrick, 38 by 38-ft. base, in West Texas (Journal, March 9, 1946). But trip savings are not alone the cost-reducing item in the Shell operation. It has been "walked," or skidded, more than a half mile across the sand hills of West Texas, saving 14 days over tearing down, moving in pieces, and rebuilding.

Speaking of derricks, the portable masts have even taken to water—that is, in Gulf Coast offshore operations (Journal, April 20, 1946). Used on power barges, they have racked 143 stands of 3½-in. o.d. drill pipe. These masts with their bulge-type rack, incidentally, raise or lower in only 20 minutes.

Standard Oil Co. of California has tried out several models of an electrical eddy current dynamometer as a rotary brake (Journal, April 20, 1946). It has been used on three 11,000-ft. wells. Mounted in the conventional place on the draw-works base, the brake shaft is coupled directly to the drum shaft of the draw works.

Other mechanical items of interest on drilling rigs lie in the compounding of power-driven slush pumps, the newer diesel-electric rigs, and those that are unitized or mobilized to facilitate transportation.

For the future there may even be rigs using hydraulic hoisting mechanisms (Journal, May 18, 1946), and a one-man seismograph drill is in operation that has both a hydraulically rotated and hydraulically lifted rotary table (Journal, March 31, 1945).

But rates of penetration count very heavily in drilling operations. Use of up to 600 ft. of heavy drill collars is one promising feature in hard-formation drilling (Journal, June 8, 1946). The application of weight to a drilling bit must be done through the compression of drill stem immediately above the bit. In order to get efficient penetration weights, as much as 40,000 lb. may need be applied to 8¾-in. bits. If this weight is applied by means of drill pipe alone, it would require approximately 2,760 ft. of 4½-in. drill pipe in compression to attain 40,000 lb. of bit weight. Compression of this amount of drill pipe will bend it so that a considerable amount of the weight will be supported by the walls of the hole and will be ineffective for bit weight. Use of multiple collars will concentrate the bit weight in a shorter, more rigid section above the bit and reduce the loss of weight to the wall of the hole.

Of course, in the drilling campaign for any field, the operations become more streamlined, efficient, and economical as experience is developed and after more alternative methods are tried out and analyzed side by side, as to footage time, relative costs, casing programs, and other factors. For example, side-by-side diagrammatic illustrations of different ways to drill and complete wells in the Rangely field have shown the operators the key factors involved with the different possible programs that can be followed (Journal, Jan. 19, 1946). Similar procedures will be helpful whether the drilling is in the Eastern, Mid-Continent, Southwestern, or Pacific Coast districts.

It is not inappropriate, in passing over some of the highlights on recent drilling activities, to mention the establishment of the most recent deepest rotary-drilled test. This was done by Phillips Petroleum Co. (Journal, Aug. 18, 1945). Location was the 3 Schoeps in the E. M. Millican Survey, Brazos County, Texas, drilled to a total depth of 16,655 ft. with only one ½-day fishing job. The record depth was reached in a total of 315 operating days. Nine pilot reamers, 27 drag bits, 133 rock bits, and a total of 3,122 tons of mud in addition to 253 tons of chemicals were used.

Completions

Well completions are the common ground where drilling engineers and production engineers get together in an important way. Of course, they are working together in development programs, coring, reconditioning work and elsewhere, but in completions the drilling people have to make the actual jobs, sometimes using special drilling muds—and with the production engineers now conducting completion tests on productivity indices and checking them against what was indicated as possible from core permeability tests. Such tests lately were done in several California fields with special water-base muds (Journal, May 11, 1946) and also with oil-base muds (Journal, Apr. 27, 1946). Determinations of true interstitial water content of cores taken with oil-base muds also have been worked on further (Journal, May 25, 1946) and the handling equipment for such drilling fluids improved (Journal, June 1, 1946).

Wells also must be recompleted, or

(Continued on page 219)

Both are tough... but ONE is tougher!

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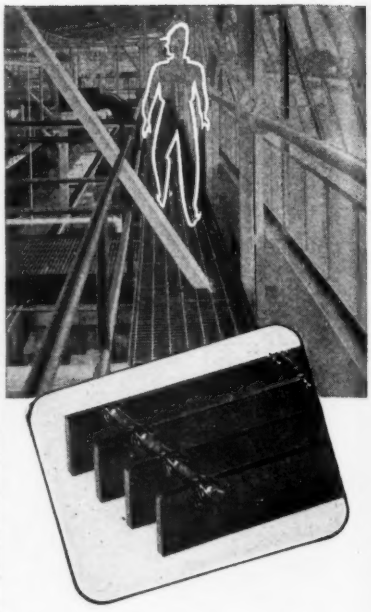

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Moving a joint of pipe in place on the San Joaquin Valley pipe line of Standard Oil Co. of California, pumping in which started this month

1946 Pipe-Line Construction Program One of Largest in Peacetime History

by R. B. Tuttle

PIPE-LINE projects authorized and under way the first 6 months indicate that expenditures for improvement in existing facilities and for new construction in 1946 will be one of the largest in the peacetime history of the petroleum and natural-gas industries. Product and natural-gas pipe-line construction have been outstanding in the projects so far announced this year. All projects are estimated to total approximately 9,000 miles for crude, products, and natural-gas lines.

Of the gas-pipe-line projects planned by a single company, that of Michigan-Wisconsin Pipe Line Co. is the largest. This line is proposed to serve the industrial areas within the Michigan-Wisconsin region. Orders totaling $19,000,000 approximately are reported to have been placed recently for the 26-in. pipe for this Michigan-Wisconsin project. Second in length of the new gas-line projects is the Texas-California carrier which will serve the Los Angeles area. This line, which is approximately 1,200 miles long, is a joint project handled

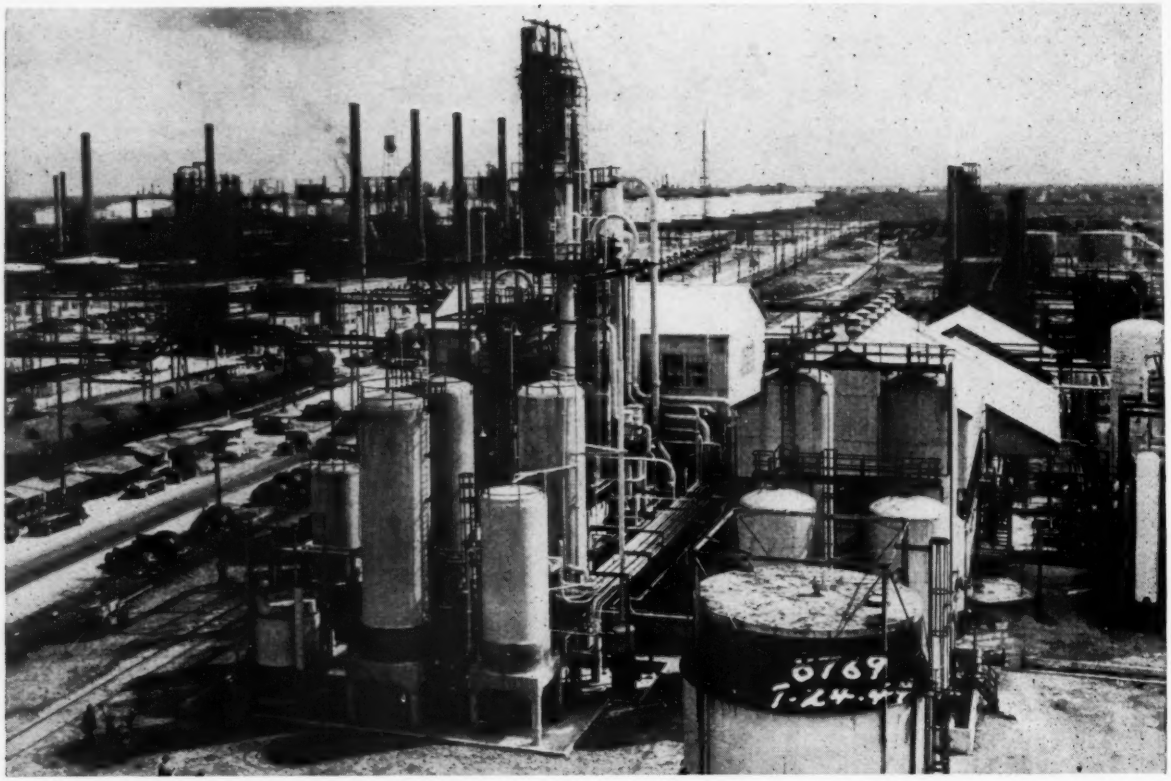
(Continued on page 215)

TABLE 1—DATA ON MAJOR PRODUCTS LINES, 1946

Company—	miles	(in.)	Status	Location
Great Lakes P. L. Co.	600	...	Planned	Five midwestern states
Great Lakes P. L. Co.	85	8	Under way	Kansas
Great Lakes P. L. Co.	205	8	Under way	Kans. City-Omaha
Great Lakes P. L. Co.	312	6-8	Under way	Iowa-N. Dakota
Humble	265	8	Under way	Texas
Sinclair	170		Under way	Ohio-Michigan
Sinclair	225	6	Under way	Ohio
Warren Petroleum Co.	29	6	Complete	Texas
Warren Petroleum Co.	21	8	Complete	Texas
Warren Petroleum Co.	32	6	Under way	Texas
Wood River Refining Co.	70	8	Under way	Illinois
	2,014			

TABLE 2—LARGER GAS-TRANSMISSION PROJECTS

Company—	Approx. miles	Size (in.)	Status	Location
Ark.-La. Gas Co.	22	Various	Under way	Arkansas
Cincinnati Gas & Trans. Co.	70	14	Under way	Kentucky
Cities Service Gas Co.	405	26	Planned	Hugoton to K. C.
Cities Service Gas Co.	71	12-16	Under way	Oklahoma
Columbia G. & E. Co.	250	Various	Planned	Misc.
El Paso Nat. Gas Co.	1,000	24-26	Planned	Texas to Calif.-Arizona line
Kansas-Nebraska Gas Co.	10	6	Near comp.	Dundee area
Michigan Nat. Gas Strg. Co.	150	24	Planned	Michigan
Michigan-Wisconsin P. L. Co.	1,285	26	Planned	Texas to Mich.
Mississippi River Fuel Corp.	265	22	Planned	La. to St. Louis
Montana Dakota Utility Co.	28	10	Planned	Montana area
Northern Natural Gas Co.	250	Various	Under way	Misc.
Panhandle Eastern	75	Various	Under way	Misc.
Southern California et al	214	30	Planned	California
United Gas P. L. Co.	30	12	Planned	Misc.
	4,125			



Methylethylketone dewaxing unit of Gulf Oil Corp.'s new aviation lubricating-oil plant, Port Arthur, Tex.

Postwar Refinery Operations Capitalize on Skills Developed During Emergency

by Arch L. Foster

PRACTICALLY all technological advances in postwar refining have been made in the realm of capitalizing on the remarkable discoveries and advances during the war period, results achieved under the terrific pressure exerted by the war's insatiable demands for more and better products to win the war. War is always a catalyst to hasten the reaction for developing processes and products which under peace conditions would follow along more leisurely to reach fruition in a more orderly manner. Regardless of the uneconomic cost of such rapid advances, so far as technology itself is concerned, the net profit is research greatly speeded up, useful discoveries made ahead of time to the (technologic) advantage of all concerned.

It was stated during World War 2 that the result of war is to rush processes and scientific progress through in a year or two which normally would require a decade to a quarter century to perfect. This appears to be true especially in refining technology, on which so much of the production of war's material depended. Aromatic hydrocarbons are well nigh indispensable to modern war, because of their importance as explosive intermediates. Several refiners knew that the hydroforming process forms large amounts of aromatics, benzene, toluene, and homologues. It is highly probable that none knew that, when operated full tilt, our American hydroforming units were making several times more aromatics than could be made from all coal tar available. And that superfractionation, combined with a relatively new commercial development, the use of azeotropic distillation methods, is all that was required to concentrate this material for immediate use for the most critical of purposes. These things were discovered, rather unearthed, and the result was entirely adequate quantities of toluene and benzene for blending into aviation fuels, for T.N.T. explosive, and for synthesis of styrene, indispensable for synthetic-rubber manufacture in huge quantities. The wartime history of many other developments is analogous.

Because synthetic rubber was a forced development of the war, essentially petroleum-derived but a very special product, it will not be touched on here except to note that the meticulous, inch-by-inch, slow development of improved techniques and modifying agents gradually are resulting in greatly improved rubber. It has been said that the progress in natural rubber in a generation has

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been compressed into 5 years with the synthetic substitute, an apparently true statement.

Catalytic Cracking

The most important single technical field in postwar refining is evidently catalytic cracking. Catalytic cracking, among other things, raises the average, over-all octane rating of motor and aviation fuels; it improves especially the octane rating of the heavier ends of these fuels, permitting the refiner to make either higher octane rating fuels from the same stocks, or higher yields of the same octane-number gasolines. The process also may be used to form larger amounts of both olefins and isoparaffins, usable as intermediates for other processes as alkylation, polymerization, condensation, and for chemical syntheses.

Much of the catalytic processing carried out during the war was done in units which were rushed from "test tube to towering giant" units, due again to the exigencies of war which did not permit the steps through small and large pilot plants, with their "bug"-removing advantages. Consequently many of the recent developments in catalytic cracking have been, in effect, to go back and retrace many steps which result in the simplification of design, of process and the attainment of results at lower costs with better products. It is true that much research work had been done during the 10 years prior to 1942, on catalytic cracking, yet the more recently developed processes had had little attention in especially large pilot-plant stages.

Therefore work to advance these processes has resulted in rapid simplification in design and operation. At least three simplified processes, Cycloversion, Fluid and T.C.C., have been developed since the end of the war, their major purpose being to fit the principles of each process to economic application to smaller capacity installations. Of the Cycloversion process relatively little has been published. It is recommended for conversion of existing thermal cracking units with relatively small additions of new equipment, as well as to entirely new installations designed on the fixed-bed, regeneration-in-place principle. In this regard there are at present four catalytic cracking units including the Cycloversion process; the others are Fluid, Houdry, and T.C.C., all three having considerable numbers of installations, whereas Cycloversion has only one known major-sized unit in operation at present.

Two revisions of the Fluid process have been worked out, looking especially to the smaller units but applicable to all sizes. The Kellogg development reduces materially the over-all height of the units, simplifies design and equipment requirements in details too numerous to outline here, and thus reduces the original investment, and it is explained that these units will produce gasoline of the octane rating and other properties required by coming competition at costs, before depreciation charges, varying from about 5.3 cents per gallon to about 5.6 cents.

In the U.O.P. revision of the Fluid cracking process the reactor is superimposed on the regenerator-catalyst hopper section to reduce the equipment needed and simplify the entire design; in other cases the regenerator may be placed below the reactor but not directly beneath. The over-all height of a 3,300-bbl. unit is said to be about 125 ft., compared to more than 200 ft. for wartime large units.

Recent developments in the Houdry (fixed-bed) catalytic process, commercially the pioneer process in American modern catalytic cracking, have been little publicized as yet. It is understood that new ideas regarding methods for handling catalyst, especially for replacing catalyst in the reactors whereby such replacement is very greatly expedited, will improve the economic position of this process in postwar applications.

The T.C.C. process has also simplified its unit design especially in the catalyst elevators as well as in other items. This process is described

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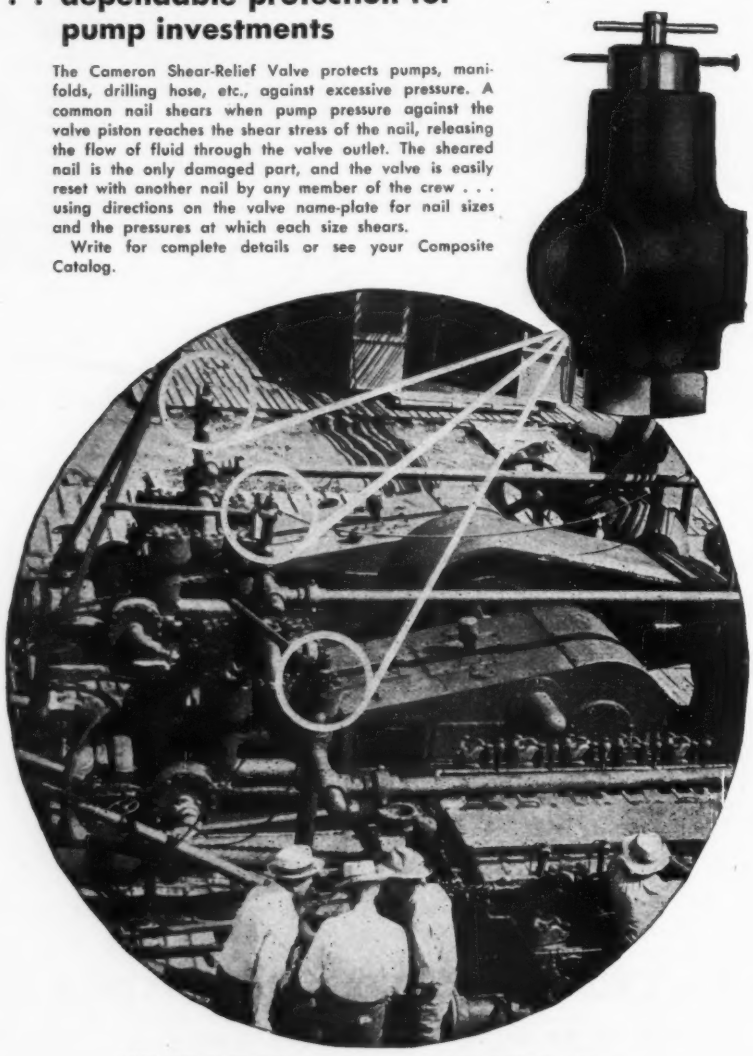

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as a moving-bed process, wherein the catalyst bed is continuously replenished at the top of the reactor and as continuously the spent catalyst is removed from the bottom of the reactor, the entire bed moving slowly downward through the reaction zone. Velocity of motion of this bed has been made lower and lower; the Thermofor kiln for regeneration has been improved by installing steam-producing coils at intervals for the double purpose of utilizing the heat of regeneration and for cooling the catalyst during the regeneration step. Catalyst moves through the reactor at 6-12 in. per minute, and in the transfer lines 1 to 2 ft. per second, it is stated. Gasoline yields for this process may be varied from somewhat higher than 40 per cent in single-pass operations to about 65 per cent for a 1.0/1.0 recycle operation, it is claimed, with relatively small increase in equipment and investment for the recycle method compared to the once-through setup. The improvements noted for these various processes are only a few of the many which have been reported during 1946. Catalyst developments will be mentioned below under that title.

Catalytic reforming has received less attention recently. The hydroforming process is considered generally as a type of reforming operation in which hydrogen is mixed with a naphtha fraction and the mixture treated with a catalyst at elevated temperatures and pressures. Standard Oil Co. of California has announced a catalytic reforming unit which adds process-produced gas, largely hydrogen, to a naphtha and heats the mixture at 1,000° F. and 200 psig. in the presence of an alumina-molybdena catalyst to form gasoline of higher octane rating, and containing large amounts of aromatics, naphthenes and isoparaffins.

New Catalysts

Both "natural" and synthetic catalysts have been used for some time in catalytic cracking and thus are not new to 1946. Recent developments indicate that the use of the initially more expensive synthetic product is more efficient and economical than the natural catalysts. T.C.C. catalysts, it is said, can be maintained at 30-31 activity index for the natural product, with a 0.5 to 0.6 lb. per barrel makeup, while the synthetic catalyst can be held at 34-36 A.I. and 0.15 to 0.27 lb. per barrel makeup. The improvement in product quality claimed when using the synthetic product makes an additional proof of the greater operating advantage of using synthetic catalysts. The recently developed MS (microspherical) catalyst appears to offer interesting possibilities for improvement.

In other processes some new catalyst advances have been made. For alkylation it is reported that 1 per cent or more of alumina in silica makes an active alkylating catalyst. Hydrogen halides or organic halides themselves are good alkylation catalysts in which the organic radical enters the final product, without use of other catalysts, it is claimed. Antimony tetroxide has proved to be a good aromatization catalyst promoter when added in 8-10 per cent concentration to a chromia-alumina aromatizing catalyst. Bauxite, largely alumina derived from natural sources, is claimed to be an excellent dehydrogenating catalyst for making styrene from ethylbenzene; a bauxite from Surinam (Dutch Guiana) showed the highest yields but that from Alabama holds its efficiency 25 per cent longer and is most efficient.

Fischer-Tropsch Developments

Progress in this field has been in developing and perfecting catalysts, equipment and procedures to improve yields and properties and reduce costs. Keith of Hydrocarbon Research, Inc., reports that gasoline made by the Hydrocol process will cost 3½ cents per gallon before depreciation charges and 5.25 cents per gallon including all interest, depreciation, and amortization charges. A unit for this

(Continued on page 216)

Tool Maker* Answers Tin-Base Bearing Problem with DEFENDER BEARING METAL . . .

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DEFENDER Bearing Metal, developed by Magnolia metallurgists as a "stand-in" for high tin-base babbitts, is alloyed for malleability, strength and toughness. It has proved efficient in 90% of all applications where sustained heavy pressures and shock loads are present. *It will not crack or chip!*

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. . . of catalytically cracked distillate fuel oils

by S. P. Cauley and E. B. Delgass

THE widespread use of catalytic cracking for production of high-octane aviation and motor gasoline, coupled with an increasing demand for domestic fuels, has presented a new problem to petroleum refiners. During the war it was not possible to give much consideration to the fuel requirements of various types of domestic burners, but in today's peacetime operations a serious study is being made of the effect of catalytically cracked distillate fuel oils upon domestic heating oils as well as upon diesel fuels.

Rapid changes in composition of domestic heating oils during the war caused adverse criticism of catalytic fuel oils, but little credit was given to the fact that catalytic cracking provided more home heating oils with greater utilization of our crude-oil resources than would have been possible otherwise. These changes created the impression that all catalytic fuel oils were alike, and less efficient than thermally cracked stocks. Most of these impressions have been corrected by the refiners[1,2,3] and they are now endeavoring to evaluate their catalytic fuel oils with respect to the requirements of domestic burners, most of which were designed primarily for use with straightrun fuels.

Refiners and oil-burner manufacturers have had little opportunity to determine the minimum quality requirements of a domestic heating oil necessary for satisfactory performance. Evidence of this fact was shown by the inauguration of such activities by the American Society for Testing Materials. Obviously the problem would be simplified if the minimum quality would be expressed in relation to some "key" physical property of an oil and its distillation characteristics. It was felt that the carbon-hydrogen ratio of an oil was most indicative of performance, and the purpose of this article is to present the results of studies for estimation of carbon-hydrogen ratios on the basis of common physical test data, and to show its application to laboratory evaluations of some catalytically cracked distillate fuel oils.

Estimating Carbon-Hydrogen Ratios

Since a literature search failed to produce an apreciable amount of data on carbon-hydrogen ratios of distillate fuel oils, and some doubt existed as to the accuracy of those data which are available, a correlation of C/H ratio was attempted using data on pure compounds. It had been generally accepted that the U.O.P. "K" factor[4] and diesel index are rough measures of relative paraffinicity, and attempts were made to correlate these factors with C/H ratios of pure compounds. Preliminary trials with the U.O.P. "K" factor, using the data of Doss[5] were disappointing as scattering of points was rather severe. However, the correlation with diesel index showed a very definite trend, and after making a boiling point correction, a reasonable correlation was obtained. The final correlation is shown in Fig. 1, in which an arbitrary factor "A" is plotted against C/H ratio. Factor "A" is equal to the numerical value obtained when subtracting one-twentieth of the boiling point from the diesel index.

Table 1 gives the data on pure compounds that were used in plotting Fig. 1. It will be seen that some of each class of compounds scatter over a range of ±3 "A" and it is possible that a further adjustment of boiling point correction would decrease the scattering somewhat.

A nomograph, based on Fig. 1, is shown in Fig. 2.

Having established a correlation of C/H ratio of pure compounds with common physical properties, it was then of interest to observe the application of the correlation for use with distillate fuel oils. This was done with data from recent work of the A.S.T.M.[6] (Technical Committee E) in which analyses of carbon and hydrogen contents of burner "reference fuels" were provided by the U. S. Bureau of

Stephen P. Cauley was graduated from Rose Polytechnic Institute in 1934 with a B.S. degree in chemical engineering. He joined Socony-Vacuum Oil Co., Inc., at the East Chicago refinery in 1936. In 1939 he was transferred to the technical service laboratories in Brooklyn. He is now in the product engineering division of the gasoline and fuel oil department, New York City, where he is executing programs on liquefied petroleum gas, distillate fuel oils, residual fuel oils, and gas-enrichment oils.

Eugene B. Delgass was graduated from New York University in 1935 with a B.S. degree in chemical engineering. He has been employed by Socony-Vacuum Oil Co., Inc., since 1936, in refinery-engineering service and technical service to the field. During the war he was assigned to the aviation gasoline advisory committee of Petroleum Industry War Council. Delgass is supervisor of product engineering division of the technical service laboratories, Socony-Vacuum Laboratories in Brooklyn.

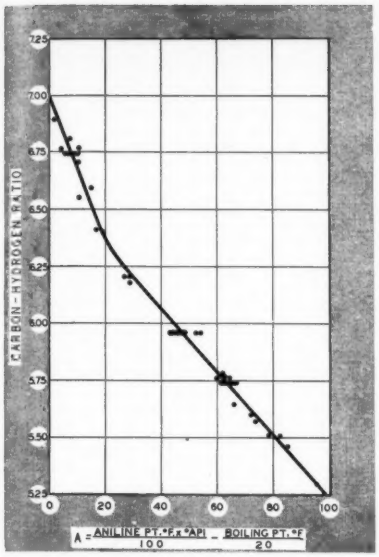

Fig. 1

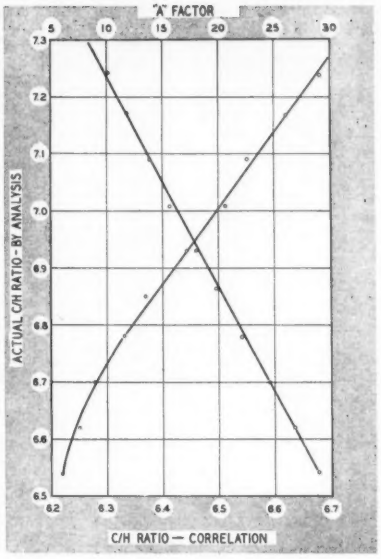

Fig. 3

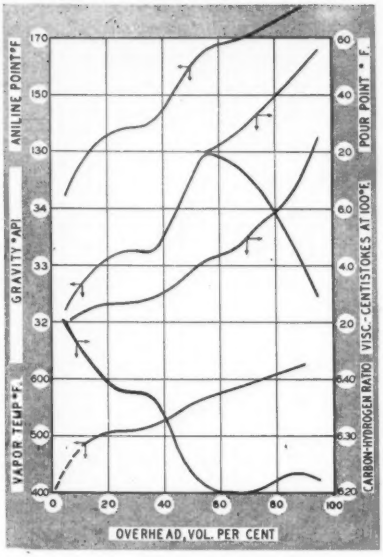

Fig. 4

Standards. The comparison of actual C/H ratios and those estimated from use of Fig. 1 is shown in Fig. 3. The A.S.T.M. 50 per cent point was used in calculating C/H ratios of the distillate fuels. Also shown in Fig. 3 is the relation of the factor "A" to actual C/H ratio. Although the amount of data available is not sufficient to establish clearly the relation shown in Fig. 3 it was considered adequate to provide support for use of the new method in fuel studies until sufficient data were obtained.

Carbon-Hydrogen Ratios of Catalytically Cracked Distillate Fuel Oils

The method of estimating carbon-hydrogen ratios shown in Fig. 1 was used to study catalytically cracked distillate fuel oils produced in Socony-Vacuum's refineries. A sample of each oil was fractionated in a laboratory true-boiling-point still and physical tests were obtained on each cut. These data were plotted on a mid per cent basis against volume per cent overhead. Physical tests of the fuels evaluated are shown in Table 2.

Plots showing evaluation of the various catalytic stocks are shown in Figs. 4, 5, 6, 7, 8, 9, 10, 11, 12.

It will be observed that the carbon-hydrogen ratios of fuels derived from intermediate type charging stocks have higher carbon-hydrogen ratios in the more volatile fractions than in the heavier fractions. This means that the heavier fractions are more paraffinic than the lighter fractions. The carbon - hydrogen ratios of distillates derived from naphthenic type charge stocks have less variation throughout the distillation range, and tend to show a reverse trend of those from intermediate stocks.

The estimated C/H ratios of distillate fuel oils, based on Fig. 1, have been used in our combustion tests of

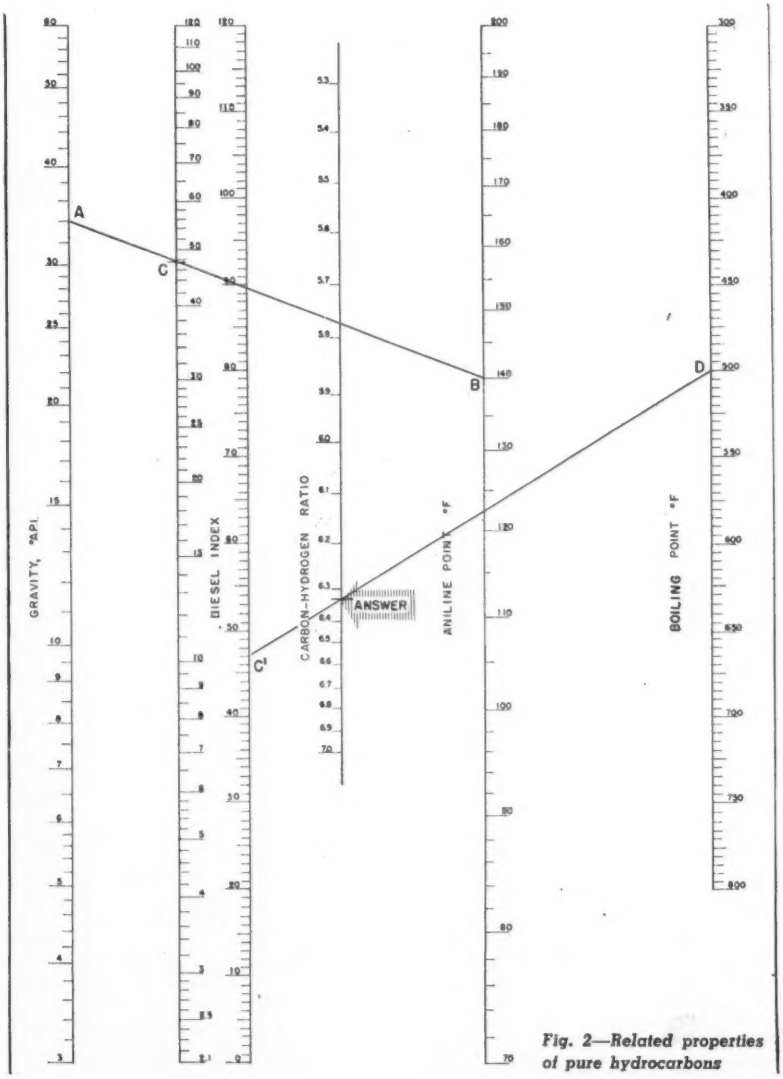

Fig. 2—Related properties of pure hydrocarbons

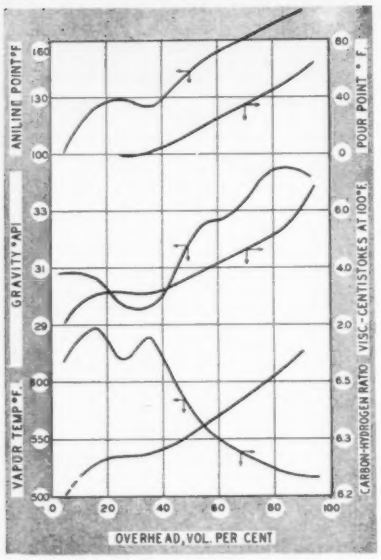

Fig. 5

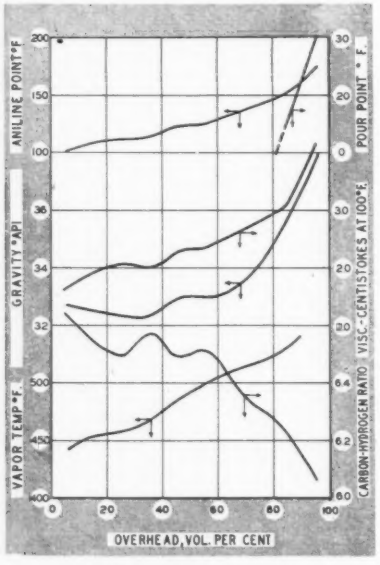

Fig. 6

domestic fuels and have shown a good correlation with the relative performance ratings of such fuels. The same correlation was used by Western Petroleum Refiners Association in their recent report[7] on tests with vaporizing pot-type oil burners. This report showed that the smoke measurements and carbon deposits observed with various fuels were related to the estimated carbon-hydrogen ratios of the fuels tested.

It can be seen from the equation for factor "A" that, if the boiling range of fuels being considered is fixed, estimated C/H values are proportional to diesel index values.

The lower carbon-hydrogen ratios of heavy fractions of catalytic stocks derived from intermediate type charging stock is of interest in connection with performance in vaporizing pot-type burners. In these types of burners it is desirable to avoid excessive

TABLE 1

Formula C	Formula H	No.	Boiling pt. (°F. at 760)	Aniline pt. (°F.)	Gravity, °A.P.I.	Diesel index	"A" factor	Ratio C/H
Paraffins								
8	18	201	233	161.6	67.0	108.1	95.4	5.29
11	24	202	384.4	177.1	58.9	104.3	85.1	5.46
12	26	203	421	182.7	56.7	103.7	82.5	5.50
14	30	204	484	193.1	43.2	102.7	78.3	5.57
16	34	205	536	203.2	50.4	102.3	72.1	5.60
18	38	206	586	200.8	47.6	95.6	66.3	5.64
25	52	25	746	232.9	44.2	102.9	65.6	5.72
26	54	51	769	237.9	43.7	104.0	66.5	5.74
26	54	1	770	236.8	43.6	103.3	65.3	5.74
26	54	2	768	237.9	43.7	104.0	65.6	5.74
26	54	3	770	237.6	43.7	103.8	65.3	5.74
26	54	4	773	237.2	43.3	102.6	63.9	5.74
26	54	22	740	233.6	42.2	98.6	61.6	5.74
26	54	23	735	233.8	42.3	98.9	62.1	5.74
26	54	55	747	232.3	42.9	99.7	62.3	5.74
26	54	67	758	238.8	44.0	105.1	67.2	5.74
26	54	106	795	240.8	43.7	105.3	65.5	5.74
26	54	109	790	240.8	43.0	103.6	64.1	5.74
28	58	5	803	243.9	43.9	104.7	64.5	5.75
28	58	63	809	243.0	43.0	104.5	64.0	5.75
30	62	6	836	242.4	42.1	102.0	60.2	5.76
31	64	8	852	250.5	42.1	105.4	62.8	5.76
32	66	7	866	253.6	42.0	106.3	61.0	5.77
34	70	107	898	258.8	41.2	106.7	61.8	5.78
Naphthenes								
7	14	207	218.1	98.1	52.7	51.7	40.8	5.96
8	16	208	267.4	112.1	50.1	56.2	42.8	5.96
9	18	209	315	119.7	48.3	57.8	42.0	5.96
25	50	110	755	219.2	38.5	84.4	46.6	5.96
26	52	117	806	229.6	38.5	88.3	48.0	5.96
27	54	74	792	226.9	38.0	86.2	46.6	5.96
9	18	210	310	121.6	46.3	56.3	40.8	5.96
10	20	211	357	129.9	44.7	58.1	40.2	5.96
10	20	212	340	135.3	45.4	61.4	44.4	5.96
11	22	213	395	141.3	43.8	61.9	42.1	5.96
11	22	214	379	142.9	44.3	63.3	44.3	5.96
14	28	215	478	166.5	41.3	68.7	44.8	5.96
22	44	216	677	214.2	39.3	84.1	40.2	5.96
24	48	217	728	224.1	37.9	84.9	48.5	5.96
25	50	88	758	220.6	37.8	83.4	45.5	5.96
26	52	75	796	225.9	36.6	82.6	42.8	5.96
26	52	76	790	224.6	36.8	82.6	43.1	5.96
26	52	77	784	224.1	37.0	82.9	43.7	5.96
26	52	78	789	223.5	37.0	82.6	43.1	5.96
26	52	100	811	231.4	37.9	87.5	46.9	5.96
26	52	102	801	228.2	36.8	84.2	44.2	5.96
26	52	104	787	225.1	36.6	82.4	43.0	5.96
27	54	60	803	227.3	76.8	83.6	43.4	5.96
28	56	91	809	226.6	36.8	83.4	42.9	5.96
31	62	69	841	239.9	36.4	87.3	45.2	5.96
Dicyclics								
11	20	218	420	108.5	30.4	33.0	11.0	6.54
14	26	219	523	141.8	30.4	43.1	17.0	6.41
25	48	19	772	209.1	31.3	65.5	26.9	6.20
25	48	111	767	204.8	32.8	67.2	28.9	6.20
28	54	65	819	221.2	31.8	70.3	29.4	6.17
Olefins								
8	16	220	251	40.5	67.3	60.8	48.2	5.95
9	18	221	293	100.4	62.8	63.1	48.4	5.95
16	32	222	564	162.3	49.8	80.9	52.7	5.95
25	50	26	736	212.0	42.8	90.8	54.0	5.95
Aromatics								
22	38	223	695	109.8	33.5	36.8	2.0	6.89
24	42	224	688	123.3	34.1	42.1	7.7	6.80
25	44	10	748	145.9	33.4	48.7	11.3	6.76
25	44	87	758	127.6	33.2	42.3	4.4	6.76
26	46	79	787	142.3	33.4	47.5	8.2	6.73
26	46	80	774	142.5	33.4	47.6	8.9	6.73
26	46	81	772	144.0	33.6	48.4	9.8	6.73
26	46	82	772	146.1	33.7	49.3	10.7	6.73
26	46	99	810	138.0	33.5	46.2	5.7	6.73
26	46	101	794	135.7	33.4	45.3	5.6	6.73
26	46	103	777	141.8	33.4	47.4	8.5	6.73
27	48	9	794	150.9	33.7	50.8	11.1	6.69
31	56	68	866	174.9	33.5	58.6	15.3	6.58
27	46	52	790	118.8	31.7	37.7	—1.8	6.98

Nomenclature

201	3,3-Dimethylhexane
202	Normal undecane
203	Normal dodecane
204	Normal tetradecane
205	Normal hexadecane
206	2,8-Trimethyl tetradecane
207	Ethyl cyclopentane
208	n-Propyl cyclopentane
209	Butyl cyclopentane
210	Propyl cyclohexane
211	n-Butyl cyclohexane
212	i-Butyl cyclohexane
213	n-Amyl cyclohexane
214	i-Amyl cyclohexane
215	Octyl cyclohexane
216	Hexadecyl cyclohexane
217	Octadecyl cyclohexane
218	Cyclohexyl cyclopentane
219	1,2-Dicyclohexylethane
220	1-Octene
221	1-Nonene
222	1-Hexadecene
223	1-Methyl, 4-isopropyl, 2-dodecylbenzene
224	Octadecylbenzene

Numbers under 200 are PSC numbers as used in Pennsylvania State College papers of American Petroleum Institute Research Project 42, "Synthesis and Properties of Hydrocarbons of High Molecular Weight."

TABLE 2—PHYSICAL TESTS OF CATALYTICALLY CRACKED DISTILLATE FUEL OILS

Type of process—	Houdry	Houdry	T.C.C.	Houdry	Houdry	T.C.C.	T.C.C.	Houdry	Houdry
Sample—	A	B	C	D	E	F	G	H	I
Type of charge—	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Naphthenic	Naphthenic	Naphthenic	Naphthenic and intermediate
Inspections of fuels:									
Gravity, °A.P.I.	33.6	32.0	33.6	34.0	33.1	31.4	27.2	25.3	29.7
Distillation:									
I.b.p., °F.	476	464	444	473	432	454	419	472	459
10 per cent	512	523	469	525	494	492	466	499	492
50 per cent	545	552	487	546	531	526	505	534	520
90 per cent	598	590	518	575	590	592	574	611	592
End point	636	633	552	613	649	645	640	676	665
Viscosity at 100° F., C.S.	3.47	3.67	2.37	3.65	3.20	3.52	3.03	4.15	3.47
Aniline point, °F.	155.8	150.0	130.9	155.5	146.8	142.0	117.3	123.8	137.3
Cetane	51	49	40	55	48	40	31	32	39
Est. C/H ratio (Fig. 1)	6.28	6.37	6.40	6.27	6.34	6.43	6.82	6.86	6.54
Flash point, °F.	235	214	206	225	196	202	196	230	216
Pour point, °F.	15	20	<0	15	15	<0	<0	<0	10
Sulfur, per cent	0.26	0.24	0.28	0.28	0.28	0.35	0.17	0.17	0.18

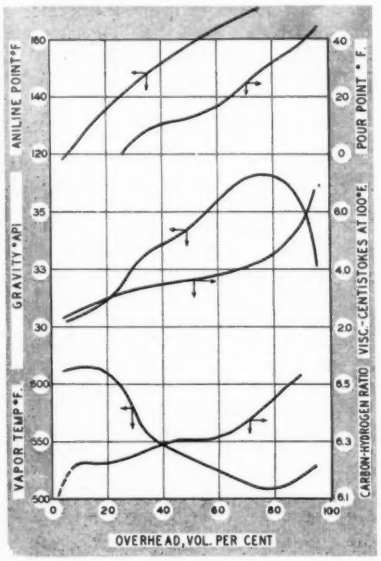

Fig. 7

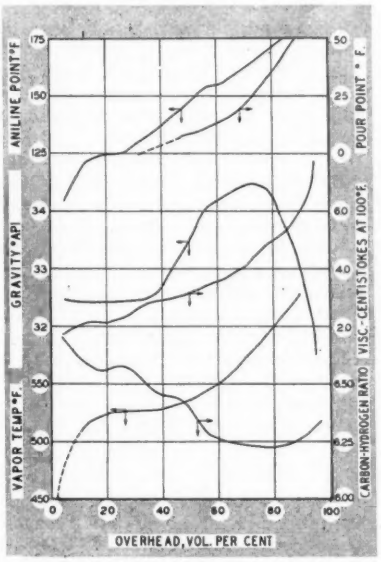

Fig. 8

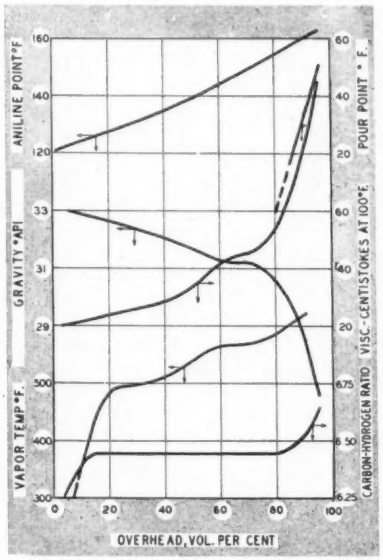

Fig. 9

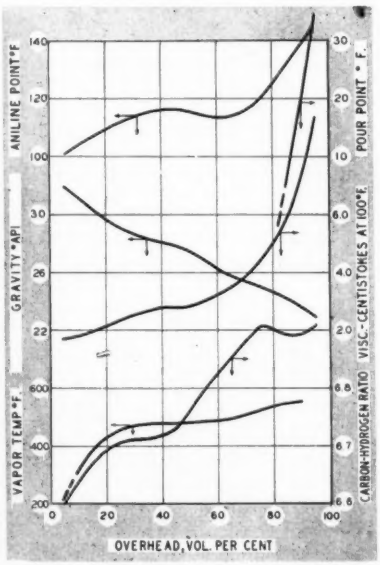

Fig. 10

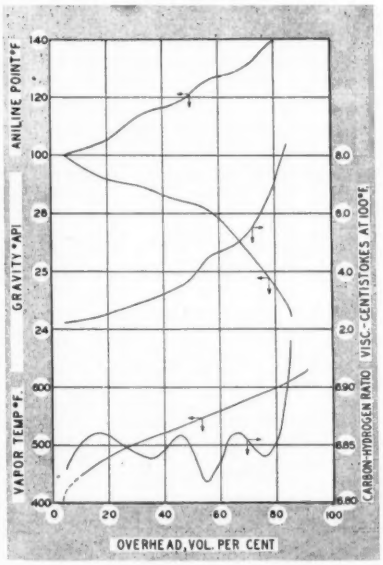

Fig. 11

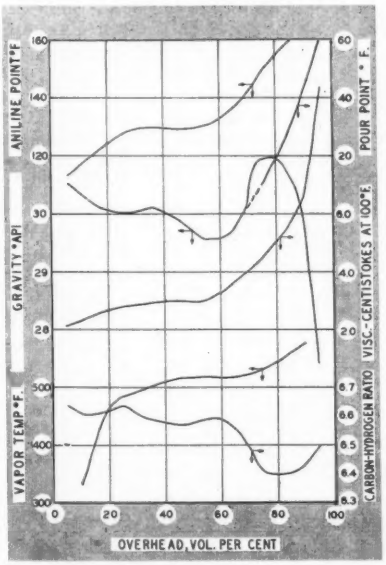

Fig. 12

carbon deposits in the bottom of the burner.

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Gas Hydrate Composition And Equilibrium Data

by E. M. Frost, Jr., and W. M. Deaton†*

ABSTRACT

This report presents data on the composition of the gas hydrate molecule of several pure gases and presents pressure-temperature equilibrium data for several pure gases at temperatures below 32° F.

The hydrate composition was obtained by direct measurement of the gas and the water resulting from the decomposition of hydrates. The composition also was calculated from the pressure-temperature equilibrium data. The compositions obtained by direct measurement and by calculations are in close agreement.

The article was presented as a paper at the meeting of the Natural Gas Department, American Gas Association, Cincinnati, May 7-8.

FOR a number of years preceding the recent war, the Bureau of Mines studied gas hydrates and their relation to the operation of natural gas pipe lines. The American Gas Association cooperated in this study. Progress reports were presented regularly at the spring convention of the Natural Gas Department of the association during the period 1937-1941, inclusive.[1,2,3,4,5] Bureau engineers continued to work on the problem from the time of the last report[5] until the start of the war, December 7, 1941. At that time the engineers were assigned exclusively to emergency war activities, and no further work has been done by them on the gas-hydrate investigations. The present report summarizes the work done during the period of May-December 1941. Data are presented on the composition of the gas hydrate molecule of several pure gases and on pressure-temperature equilibrium curves of several pure gas hydrates below the freezing point of water.

Composition of Hydrate Molecule

Several pure or essentially pure gases were investigated to determine the gas-water ratio in the hydrate molecule. In conducting the tests, the cell on the hydrate apparatus[1] was about one-fourth filled with water, and the cell pressure and temperature were adjusted to values favorable to the formation of hydrates. The gas then was bubbled through the water until the cell was essentially full of a honeycomb mass of hydrates. Flow of gas through the cell then was stopped, but static pressure was maintained above the hydrate equilibrium pressure. All excess water was drained from the cell following which the cell was kept for several days under pressure and temperature conditions favorable to the formation of hydrates. During this waiting period any water held in the honeycomb mass of hydrate should be converted into hydrate. A relatively large cylinder containing the test gas under pressure was attached to the cell during the waiting period to minimize the pressure drop within the cell caused by consumption of gas in converting additional water into hydrate. Pressure and temperature recorders attached to the apparatus during the waiting period verified the continued maintenance of the cell under conditions favorable to the formation of hydrates.

The hydrate cell then was closed off from the rest of the apparatus, the pressure and temperature were measured carefully, and the cell was warmed slowly while gas was removed and measured in small increments to maintain a constant pressure within the cell. Temperatures within the cell were measured by means of thermocouples.[1] During the course of forming the hydrates, these thermocouples would become imbedded in the honeycomb mass and thus would permit measuring the temperatures within the mass of hydrate. Temperatures were readable to 0.1° F. Pressures above about 10 psig. were measured with high-quality bourdon-tube test gages. These gages were calibrated by comparison with a deadweight gage just before the hydrate tests were begun. Gages used in measuring pressures from 10 to 100 psi. permitted readings to 0.1 psi. Gages used in measuring pressures above 100 psi. permitted readings to about 1 psi. Pressures below 10 psig. were measured with mercury-filled manometers permitting readings to 1 mm. or about 0.02 psi. The gas removed from the cell was measured in a burette permitting measurements to about 0.05 cc. Mercury was used as the confining fluid in the burette.

Determining Water Weight in Cell

The weight of water in the cell was determined following decomposition of the hydrates. Most of the water could be drained into a tared bottle and weighed. The remainder of the water was recovered by exhausting the cell to a pressure below the vapor pressure of the water, with a liquid-air-cooled U-tube in the line between the cell and the vacuum pump. The weight of water recovered in the U-tube was added to the weight of the water drained from the cell to obtain the total amount recovered.

The corrected volume of gas released from the hydrates was determined by several successive steps. First, the volume of gas as measured in the burette was corrected to the volume it would occupy if at standard conditions, in the present instance 60° F. and 14.7 psia. Second, the volume of gas in solution in the water in the cell at the end of the test was calculated and added to the volume removed from the cell during the test. The volume of gas that was removed during the test to compensate for the tendency of the pressure to rise due to the increase in temperature was then calculated, and this volume was subtracted from the total to give the

TABLE 1—SUMMARY OF DATA COLLECTED IN STUDY OF COMPOSITION OF GAS HYDRATES

Test No.	Gas used	Duration of test, days	Gas recovered, cc.*	Gas recovered, moles	Water recovered, grams	Water recovered, moles	Water-gas ratio, moles	Hydrate formula experimental
1	Carbon dioxide	3	4,699	.1998	26.5	1.47	7.36	CO_2:7.36H_2O
2	Carbon dioxide	3	2,540	.1080	14.853	.8245	7.63	CO_2:7.63H_2O
3	Carbon dioxide	2	2,461	.1046	13.605	.7552	7.22	CO_2:7.22H_2O
4	Carbon dioxide	4	3,813	.1621	20.435	1.1343	7.00	CO_2:7.00H_2O
5	Carbon dioxide	2	2,642	.1123	14.136	.7847	6.99	CO_2:6.99H_2O
6	Methane 99.7%	2	1,781	.0753	9.655	.5359	7.11	CH_4:7.11H_2O
7	Methane 99.7%	2	1,634	.0691	8.765	.4865	7.04	CH_4:7.04H_2O
8	Ethane 98.3%	1	1,192	.0509	7.391	.4103	8.06	C_2H_6:8.06H_2O
9	Ethane 98.3%	4	1,801	.0769	11.328	.6288	8.18	C_2H_6:8.18H_2O
10	Ethane 98.3%	4	1,175	.0502	7.719	.4285	8.54	C_2H_6:8.54H_2O
11	Ethane 98.3%	4	1,419	.0606	9.093	.5047	8.33	C_2H_6:8.33H_2O

*60° F. and 14.7 lb. abs.

	Formula from data above	Formula from Fig. 1 and Table 4
Methane	CH_4:7H_2O	CH_4:7H_2O
Ethane	C_2H_6:8H_2O	C_2H_6:8H_2O
Propane	.....	C_3H_8:18H_2O
CO_2	CO_2:7H_2O	.....

*Chemical engineer and †helium engineer, Petroleum and Natural Gas Division, U. S. Bureau of Mines, Amarillo, Tex.

net volume of gas due to decomposition of hydrates.

The volumes of gas and the weights of water were converted into moles, and the molecular ratio was calculated for the hydrate. The data thus collected are summarized in Table 1. Data were collected on carbon dioxide, methane, and ethane. The carbon dioxide was essentially pure being obtained from liquid in cylinders. The methane analyzed 99.7 per cent pure and the ethane analyzed 98.3 per cent. Column 2 of Table 1 shows the gas being tested; Column 3 shows the elapsed time in days during which the cell was maintained under hydrate-forming conditions after all water that would drain from the hydrate mass was removed from the cell; Column 4 shows the net volume of gas in cubic centimeters, and Column 5 the quantity of gas in moles that was combined with the water as hydrate; Column 6 shows the weight of water in grams, and Column 7 shows the quantity in moles that was recovered from the cell at the end of the test; Column 8 shows the molecular ratio of the water to the gas obtained by dividing the moles of gas (Column 5) into the moles of water (Column 7); Column 9 shows the resulting formula.

The summary at the bottom of Table 1 gives the formula to the nearest whole number of water molecules for each of the hydrates studied and also the formulas of hydrates calculated later in this report from equilibrium data for temperatures above and below the freezing point of water.

Experimental Techniques

In the course of the laboratory investigations, several different methods were tried for forming the hydrates, but no others were as successful as that wherein the gas was bubbled through the water. In one alternate method, hydrates were formed very limitedly in the cell by bubbling the gas through the water, and then all water was drained from the cell. Following this, gas which had been saturated at a temperature higher than the temperature in the cell was circulated through the cell, with the cell maintained under hydrate-forming conditions. It was hoped that hydrates would form quantitatively as moisture condensed from the gas. This method was not successful in that the rate of formation was very slow compared to the bubbling method and was discarded. In another method, a heavy copper rod was mounted in the cell with a portion of the rod extending outside the cell through an insulated bushing. Means were provided for cooling the rod below the bath and cell temperatures, so that moisture would rise from water in the cell, condense, and form hydrates on the rod. This method likewise was unsuccessful due to the very slow rate of formation of hydrates. In still another method natural gas was recirculated continuously through the cell with the cell under hydrate-forming conditions, in hopes of obtaining something approaching a quantitative conversion of water into hydrates, but the per cent conversion in any reasonable length of time was very low.

Hydrate Equilibrium Data Below 32° F.

Equilibrium data on various pure and relatively pure gases were obtained at temperatures below 32° F. In the tests yielding the data, hydrates first were formed at temperatures above the freezing point of water. After the cell was filled nearly full of a honeycomb mass by hydrates, all water that would drain was removed from the cell. Then, with pressure maintained in the cell, it was cooled and stabilized at selected temperatures below 32°. After stabilization of the temperature, gas was removed and measured in successive small increments until a point was reached where the pressure remained constant or recovered previous values upon further removal of gas.

The data collected in the tests are shown plotted in Fig. 1; the data points are listed in Table 2. The data points shown plotted on Fig. 1, in addition to those listed in Table 2, are data points reported previously[4] and redrawn on Fig. 1 to show the location of the equilibrium curves above 32° F. in the present investigation data were collected on methane, ethane, and propane. Table 3 is a typical excerpt from records of volume removed vs. cell pressure in determining the data points.

TABLE 2—HYDRATE EQUILIBRIUM DATA FOR METHANE, ETHANE, AND PROPANE

Methane		Propane	
Temp. (°F.)	Pressure (psia.)	Temp. (°F.)	Pressure (psia.)
12.6	260	10.5	14.47
15.9	276	15.8	16.72
20.0	302	21.7	19.11
23.8	322	22.0	19.53
28.0	347	26.0	21.58
		30.4	24.17
Ethane		31.5	24.92
Temp. (°F.)	Pressure (psia.)	32.4	26.28
14.7	45.4	32.8	27.84
20.0	51.8	*33.1	*27.97
25.0	58.7	33.3	29.72
30.0	66.3	36.3	42.22
		38.8	58.24

*See text.

After data on propane were collected at temperatures below 32°, additional data on propane were collected by the present technique at temperatures above 32°, because the technique used in obtaining the present data differed from that formerly used.[4] In the former investigations, a film of hydrate was formed on quiescent water in the cell, and the pressure dropped progressively at constant temperature until the film was noted to wilt and disappear. In addition to the data reported herein obtained by the new technique, a point was checked on the propane curve using the former technique. This point was at 33.1° F., and is identified in Table 2 by the (*). This point agrees closely with data obtained by the new method. The propane data above 32° presented in the present report agrees closely with propane data reported previously[4] but does not duplicate it exactly. The variations may be due to slight differences in purity of the propane. At the beginning of the hydrate investigations, several cylinders of propane

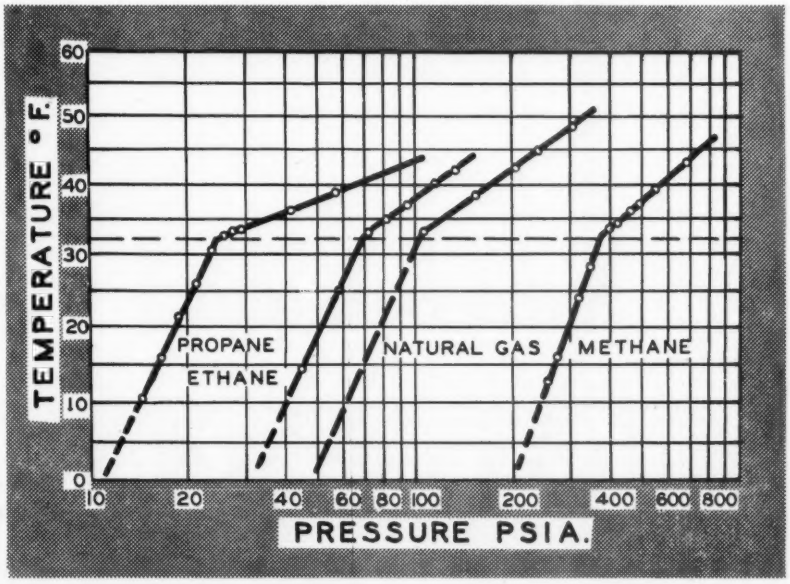

Fig. 1—Hydrate equilibrium data

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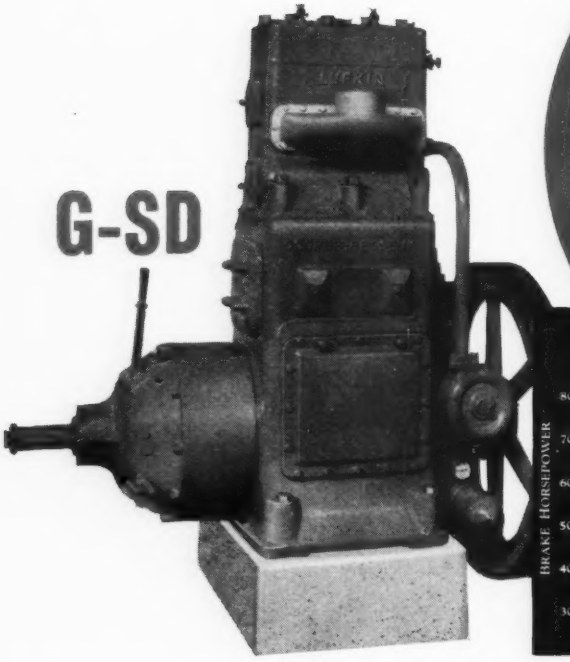

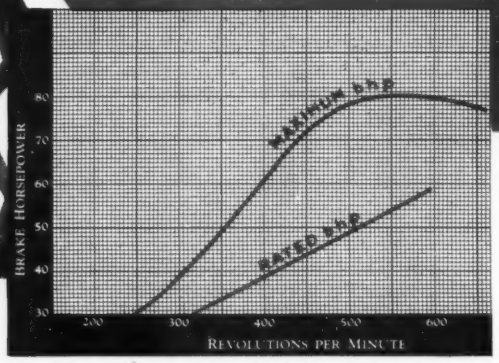

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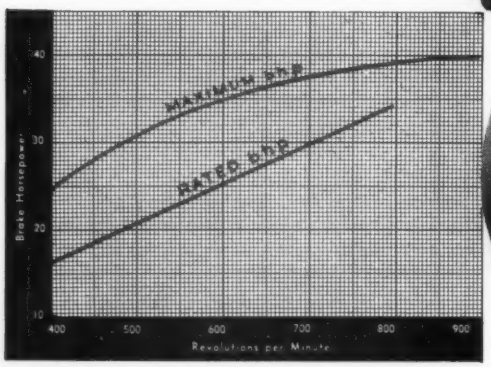

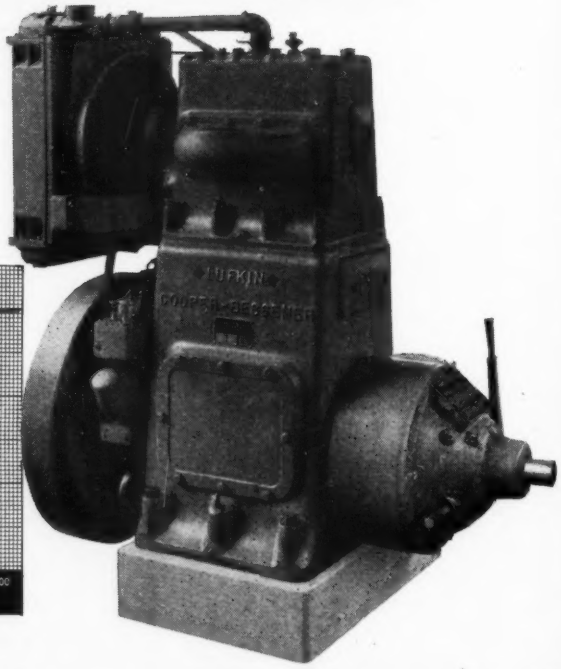

DIESEL AND GAS ENGINES

FOR COMPRESSORS, PUMPS, GENERATORS

New York Washington Bradford, Pa. Parkersburg, W. Va. San Francisco, Cal. Seattle, Wash.

were obtained from the same source. Gas from one cylinder was used in obtaining the former data and gas from another cylinder in obtaining the present data. Analyses of gas from the former cylinder gave 99.8 per cent purity, but owing to the unanticipated abrupt termination of the present work, analyses were not obtained on the gas used.

TABLE 3—TYPICAL EXCERPT FROM DATA COLLECTED IN OBTAINING HYDRATE EQUILIBRIUM POINTS AT TEMPERATURES BELOW 32° F.

Time (a.m.)	Temp. (°F.)	Volume out of cell (cc.)	Cell pressure (psig.)
9:40	135	...	45.3
9:45	135	61.9	38.1
9:49	135	0	38.1
9:54	15.1	27.1	35.5
10:00	14.9	0	35.5
10:07	14.7	15.8	33.95
10:10	14.7	0	33.95
10:13	14.7	15.8	32.30
10:18	14.7	0	32.50
10:24	14.7	0	32.62
10:27	14.7	0	32.70
10:30	14.7	0	32.70
10:33	14.7	0	32.70
10:38	14.7	10.3	32.35
10:44	14.7	0	32.60
10:47	14.7	0	32.70
10:50	14.7	0	32.70

Barometer = 12.7 lb.
Hydrate point, 14.7° F. and 45.4 psia.

Hydrate Composition Calculated from Equilibrium Data

The composition of the hydrate molecule, that is, the ratio of gas to water in the molecule, can be calculated from heats of formation of the hydrate from liquid water and from ice. The heats of formation should differ by the heat of fusion of water in the molecule. The difference in the heats of formation divided by the heat of fusion per mole of water will give the number of moles of water in the hydrate. Fortunately the heats of formation of the hydrates above and below the freezing point of water may be calculated from Fig. 1. In preparing Fig. 1, the data points were plotted as log P vs. reciprocal temperature and were found to fall on straight lines. These lines may be represented by an equation of the type:

$$\log P = A + B/T \qquad (1)$$

This equation lends itself readily to the differentiation required to solve for the heat of formation of the hydrate. Following is the mathematical analysis in calculating the heats of formation above and below the freezing point of water from the data shown in Fig. 1.

Mathematical Analysis

From the Clausius-Clapeyron equation[6] we have:

$$dP/dT = H/T\Delta V \qquad (2)$$

where

H = heat evolved or adsorbed
ΔV = change in volume of the sum of the reacting substances as a result of the reaction
T = absolute temperature
dP/dT = rate of change of equilibrium pressure with change of temperature

Solving Equation 2 for H:

$$H = T\Delta V\ dP/dT \qquad (3)$$

differentiation of Equation 1 gives an evaluation of dP/dT as follows:

$$\log P = A + B/T \qquad (1)$$

or

$$0.4343\ \ln P = A + B/T \qquad (4)$$

differentiating,

$$0.4343\ dP/P = -B/T^2\ dT \qquad (5)$$

and

$$dP/dT = -\frac{BP}{0.4343\ T^2} \qquad (6)$$

substituting in Equation 3:

$$H = \frac{T\Delta V\ BP}{0.4343\ T^2} = -\frac{B\Delta VP}{0.4343\ T} \qquad (7)$$

Any units of measurement may be used providing consistent units are selected. It is convenient to use the B.t.u. as the unit of heat, the pound mole as the unit of volume expressed in cubic feet, pounds per square inch for pressure, and °F. for temperature. The value for ΔV will not be significantly different from the pound mole volume for the gas, for the hydrate volume resulting from the hydrate-forming reaction is only slightly larger than the volume of the water entering the reaction. This small difference, in the order of 2 per cent of the volume of water or a total difference of about 0.05 cu. ft. per pound mole of gas, is insignificant in comparison to a pound mole gas volume of approximately 360 cu. ft.

Over the limited pressure ranges under consideration it may be assumed without significant error that the gas behaves as a perfect gas, hence, its mole volume at T and P of Equation 7 may be substituted for ΔV.

The use of 778 ft.-lb. per B.t.u. and the factor of 144 to convert lb. per sq. in. to lb. per sq. ft. results in Equation 7 becoming:

$$H = -BV_m \frac{144 \times 14.7}{0.4343 \times 778 \times 492}$$

$$= -0.01273\ BV_m \qquad (8)$$

V_m = lb. mole volume at 32° F. and 14.7 psia.
B = slope of equilibrium curve, obtained from Fig. 1

The mole volume, V_m, of the various gases deviates as much as 2½ per cent from the theoretical mole volume. Accordingly, the mole volume (32° F. and 14.7 lb.) was calculated for each gas by dividing the density into the molecular weight, and is shown in Column 1 of Table 4.

The slope, B, of the lines in Fig. 1 were determined from points read off the lines. For example, the following points were read from the methane curve.

Temp., °F.	Pressure, psia.
10	247
32	377
45	776

Using the reciprocal absolute temperatures, the difference between 10° and 32° is:

$$1/T_1 - 1/T_2 = 1/470 - 1/492$$

$$= 0.0000952$$

The difference in log P is:

$$\log 247 - \log 377 = -0.1836$$

Dividing $\Delta \log P$ by $\Delta 1/T$ gives:

$-0.1836/0.0000952 = -1{,}929$ = slope of line below 32° F., = B of Equation 1

By the same manner of calculation, the slope, B, above 32° = —5,996. Column 2 of Table 4 gives the values of B corresponding to the slopes of the several lines above 32°, and Column 3 gives the values of B corresponding to the slopes below 32° F. The heat of formation of the hydrates in B.t.u. per pound mole, may be calculated from Equation 8 by using the values of V_m and B from Table 4, Column 4 of this table gives the calculated heats of formation of the hydrates above 32° and Column 5 gives the heats of formation below 32°. The heat of fusion of water approximates closely 2,583 B.t.u. per pound mole. Thus, the number of moles of water in the hydrate may be calculated by obtaining the difference between the heat of formation above and below 32° (Column 4 minus Column 5, Table 4) and dividing into this difference the number 2,583, the heat of fusion of

TABLE 4—TABULATION OF DATA FOR CALCULATING HEATS OF FORMATION AND HYDRATE COMPOSITION FROM EQUILIBRIUM DATA OF FIG. 1

	V_m, cu. ft. 32° F. and 14.7 lb.	B value above 32° F.	B value below 32° F.	Heat of formation above 32° F.	Heat of formation below 32° F.	No. of moles water	Hydrate formula calculated
Methane	358.2	—5,996	—1,929	27,341	8,796	7.18	CH_4:7.18H_2O
Ethane	354.8	—7,164	—2,443	32,356	11,034	8.25	C_2H_6:8.25H_2O
Propane	349.4	—12,992	—2,567	57,787	11,418	17.95	C_3H_8:17.95H_2O
Natural gas	*357.0	—7,437	*—2,300	33,798	*10,500	9.0	x:9H_2O

*Assumed.

water per pound mole. The calculated number of moles of water in the hydrate is shown in Column 6 of Table 4, and the calculated formula is shown in Column 7.

TABLE 5—COMPOSITION AND HYDRATE DATA POINTS OF NATURAL GAS SHOWN IN FIG. 1 AND TABLE 4

		Hydrate data	
	Composition	Temp. (°F.)	Press. (psia.)
Carbon dioxide	0.3	33.0	109
Nitrogen	9.5	35.0	128
Methane	79.4	38.0	158
Ethane	5.8	42.0	203
Propane	3.6	45.0	243
Butane and higher..	1.4	48.0	304

The calculated formulas are in close agreement with the results obtained by direct measurement of the gas-to-water ratio listed in Table 1.

Fig. 1 includes the hydrate equilibrium curve for a typical natural gas. The analysis and the hydrate data points of this gas have been reported previously[4] but are repeated for convenience in Table 5. The sample of gas used was taken from the outlet of a gasoline plant in the Texas Panhandle field. No data were obtained on this gas at temperatures below 32° F. but it is reasonable to expect that the dashed line below 32° will represent closely the true equilibrium for the natural gas. The dashed line was drawn with a slope intermediate between the slopes of the methane and ethane equilibrium lines, but more nearly approaching the slope of the ethane line owing to its closeness to ethane line. This natural-gas curve is included as it is thought that the gas industry would be interested in an estimation of the equilibrium data for a typical natural gas at temperatures below 32° F. Similarly, the heat of formation and the hydrate formula of this natural gas were calculated using the assumed slope of the equilibrium curve below 32°. The heat of formation and the calculated hydrate formula for the gas are included in Table 4.

Discussion

The nature of the hydrate formed from natural gas is not understood. In the course of the laboratory work a circulating system was assembled wherein natural gas could be recycled continuously through the cell. Upon starting this system, hydrates were observed to form readily at first, but the rate of formation decreased progressively until an almost negligible rate was obtained. The authors never were able to reach anything like a quantitative conversion in the laboratory by this method. Various speculative theories were considered in trying to account for this decreasing rate of formation. Among these is the thought that possibly the hydrates are formed from some of the polymers of water such as $(H_2O)_2$ or $(H_2O)_3$. Such a possibility was suggested by Bouzat[7] as an explanation of the variation in the molecular ratio of gas to water in the various gas hydrate molecules. The initial quantity of these polymers would be depleted during the initial relatively high rate of formation and the subsequent rate would be controlled by the rate of reformation of the polymers. Other explanations might be more plausible.

Tests Using Pure Gases

The slow rate of complete conversion of water to hydrates was particularly noticeable in the work on gas-water ratios and in tests below 32° F. In the tests using pure gases, the honeycomb mass of hydrates would be formed, the excess water drained from the cell, and the cell left for several days under conditions favorable to the formation of hydrates, yet there would still be evidence of free water. Sometimes after remaining quiescent at temperatures below 32° F. for a day or two, the mass would undergo a transient temperature cycle, warming to 32° F. and then recooling to cell temperatures, as though some supercooled water had frozen. This phenomenon was observed repeatedly and often could be caused in a relatively new mass of hydrate by a sudden partial reduction in pressure. No evidence was present to indicate the destruction of hydrates during these cycles.

An effort was made to isolate hydrates formed from natural gases, collect the gases liberated upon decomposition, and from the analyses of these gases obtain data upon the probable composition of the natural-gas hydrates. Several tests were run wherein hydrates were formed, and mercury at cell temperature forced into the cell under pressure to displace as completely as possible the gas and liquid phases which were removed through outlets in the top of the cell. Upon release from the cell, gases would collect in the cell, presumably exclusively from the decomposition of the hydrates. The composition of the gases thus collected defied all attempts at interpretation. Although analyses of gases evolved from hydrates that have been blown from pipe lines have been reported previously,[8] such analyses are not thought to reflect the true composition of the gas in the originally formed hydrate because of differential rates of gas liberation upon release of pressure.

The data of this report are not as comprehensive as the authors would desire. It is thought, however, that the information and data presented may prove of value or assistance to other investigators, and this report brings up to date the publication of data collected by Bureau of Mines engineers before the project was discontinued because of assignments to essential war work.

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BOOKS

PETROLEUM DEVELOPMENT AND TECHNOLOGY—1945. American Institute of Mining and Metallurgical Engineers, New York, N. Y. 665 pp. $5.00.

This latest volume of the well-known annually published series of the petroleum division of the A.I.M.E. covers papers and discussions presented at A.I.M.E. meetings held at Los Angeles, Houston, and New York. There are 15 papers in the section devoted to petroleum engineering and research, the majority of which are concerned with specific details of reservoir mechanics. There are four papers in the section on petroleum economics, and the well-known chapters on production statistics for individual oil-producing states (covering details for the year 1944) are given in the established detailed manner.

VAPOR ADSORPTION. By Edward Ledoux. Published by Chemical Publishing Co., 26 Court Street, Brooklyn. 400 pp. $8.50

During the last decade an ever-increasing interest has been focused on the phenomenon of adsorption and on industrial adsorption processes. Static adsorption is studied only from the engineer's viewpoint, who is really more interested in the next step, which is industrial dynamic adsorption, a vast field he has to explore for himself. The physical and physico-chemical background of adsorption, the essentials of vapor and heat transfer, and saturation of air are also discussed to help the engineer in the clear understanding and application of adsorption phenomena to industrial projects. The building and operation of dynamic adsorption units on an industrial scale and various adsorption problems are treated with great thoroughness and lucidity. Hundreds of diagrams and illustrations are included for easy reference.

Chemistry of Drilling Fluids

by H. T. Kennedy

Drilling muds have a way of behaving or misbehaving according to the A, B, C, and other ingredients that are put into them, or that may be lacking. Dr. Kennedy tells about this in the accompanying article, which he also presented at the Texas A. & M. College "short course" on muds earlier this year. The author is with Gulf Research & Development Co., Pittsburgh.

THE chemistry of drilling fluids is largely the colloid chemistry of the materials that maintain the fluid in a highly dispersed state. Thus, while water or oil, together with weighting material, make up the bulk of drilling muds, they are for the most part inert, and affect mainly the physical rather than the chemical properties. Since these physical properties are well discussed by other authors, this paper will be limited to the chemistry of materials such as (a) clay, bentonite, starch and gums, and agents such as tannates and phosphates which exert a controlling influence over them; and (b) asphalt, lamp black, soaps and the like, which perform similar functions in oil-base muds.

Although fineness of division is a prerequisite for the colloid state, and for the properties associated with good drilling fluids, fine grinding is not in itself sufficient to guarantee the desired characteristics. Thus, amorphous silica may be obtained in extreme fineness, and may be used as an effective weighting agent, but it does not impart to a drilling fluid the same filtrate reduction and stability against settling as does clay. The materials and processes which do impart the desired characteristics are quite different for water-base muds than for oil-base muds, and these two fluids will be discussed separately.

Water-Base Muds

Until recently, most rotary-drilling fluids consisted of water and clay, the latter material being obtained from the formations as drilled, or being added from local sources. As wells became deeper, the properties of the simple clay-water mixtures were found to be increasingly inadequate to meet the more severe requirements. Clay-water mixtures of sufficient density to control high-pressure sands were too viscous to be handled, and Stroud[1] added heavy weighting materials which increased the weight without greatly affecting the viscosity. A second step in increasing weight without sacrificing other properties was the replacing of part or all the clay with a more powerful suspending agent, bentonite, so that more of the solid portion of the mud could consist of heavy material such as barium sulfate.[2] A third step consisted in adding agents such as tannates[3] and phosphates,[4] greatly thinning the mud and allowing still higher percentages of weighting material to be added.

In modern drilling practice, increasing emphasis is placed on the wall-building properties of muds, as measured by the filtrate obtained in the Baroid tester.[5] Clay muds, without further additions, may have high filtrates (in excess of 50 cc. in 30 minutes), and may cause difficulties in drilling due to the invasion of producing formations by the separated water, and mud-ringing of the hole by the deposited cake. Loss of drilling fluid and accelerated heaving of shales may also result.

The viscosity, gel strength, filtrate and stability as regards settling are controlled, to a great extent, by the degree of deflocculation of the colloidal material in a drilling fluid. The degree of deflocculation, in turn, is frequently dependent on the presence or absence of very small amounts of certain materials, whose action is explainable in terms of their effect on the electric charges carried by the dispersed particles. The reality of these charges has been demonstrated by placing a dispersed clay in an electric field, and observing the motion of the individual particles toward the positive pole, which proves that the charges are negative. Hauser and Le Beau[6] have studied the velocity of particles of selected bentonite, and

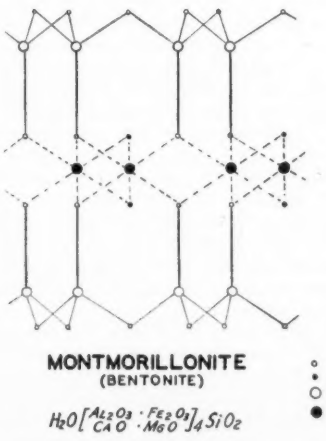


Fig. 1—Bentonite—it is a sheet, with a plane of aluminum oxide enclosed by a sheet of silicon and oxygen on each side

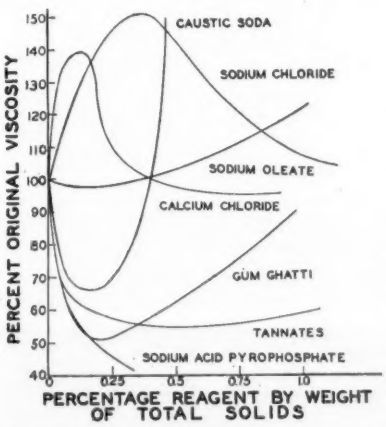


Fig. 2—Changes in viscosity produced by seven different mud reagents. Only in the lower percentages do the trends coincide

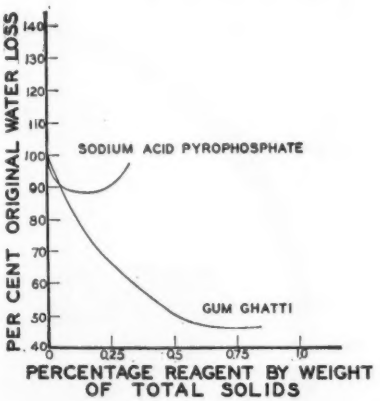


Fig. 3—The above two mud additives cut water loss

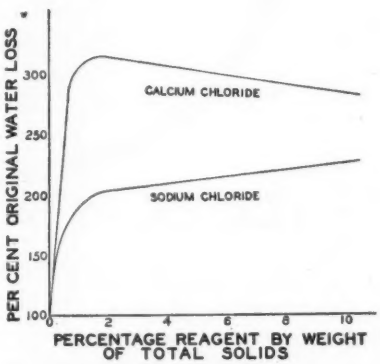


Fig. 4—These chlorides increase water loss

have calculated from the results an average apparent particle diameter of 20-96 mμ, and an average distance between particles of 94-738 mμ. The results are presented as a first approximation only.

Clays which are useful in drilling fluids consist principally of aluminum silicate, with small percentages of iron, magnesium, calcium, and alkali metals, oxides and variable amounts of water bound in the molecule. Hoffman[7] and coworkers have presented an idealized picture, based on X-ray diffraction patterns of the bentonite particle. According to these authors, bentonite exists as a sheet in which a plane containing largely aluminum oxide is enclosed on both top and bottom by sheets containing silicon and oxygen, as shown in Fig. 1. This picture has been widely accepted, and when allowance is made for substitution of other metals at various points in the lattice, may be used to explain many facts in the chemistry of clays.

According to this concept, bentonitic clay swells because water of hydration can penetrate between the aluminum-silicon planes, with excess water existing between the particles, outside the lattice. Ford, Loomis and Fidiam[6] have explained in detail the action of various viscosity-reducing agents as adsorption of negative ions of the agent on the exposed aluminum atoms on the ends of the plates, and consequent rupture of the plate structure. The gelling and coagulating action of salts is explained as an effect on the ionic atmosphere rather than on the clay particle itself.

Regardless of the detailed mechanism, certain facts of the chemistry of clay drilling fluids are well established. Small quantities (up to 0.1 per cent) of salts such as sodium chloride are beneficial in dispersing the particles and providing better stability and lower filtrates, while further increase in salt concentration leads to complete flocculation and very large filtrates. Some clays resist visible flocculation, but the increase in filtrate shows that coagulation of particles is occurring nevertheless. No practical method has been found to prevent the deterioration of clay by salts such as are encountered frequently in drilling operations, and under these conditions, reliance for colloidal properties must be placed on starches or gums which are not similarly affected.

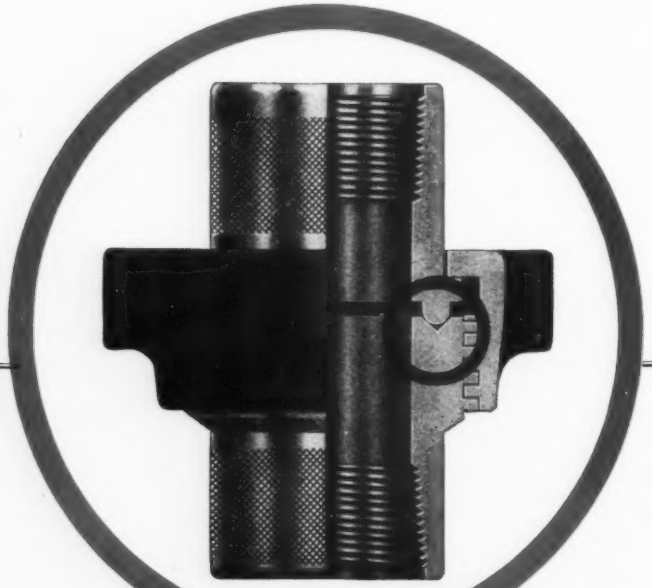
The effect of various materials on the viscosity of muds is shown in Fig. 4, for which data have been assembled from various sources. The curves are illustrative only, and are not intended to evaluate the agents, since the relative effectiveness varies from one drilling fluid to another. Fig. 4 deals only with fresh water muds.

Figs. 2 and 3 show corresponding effects on the filtrate of clay-fresh water muds of a number of materials. As in Fig. 4, the curves are not intended to show the relative effectiveness of various agents.

As previously mentioned, the effect of salts encountered in drilling is to practically destroy the colloidal nature of clays, and for this reason, it is necessary to find colloidal materials not similarly affected. Salts have little effect on dispersions of starches or certain water-dispersible gums such as arabic, tragacanth, karaya or ghatti, and, in many respects, muds formulated with these organic materials behave better with high salt content than in the salt-free condition. Due to the growing use of starch, and the prospect of greater use of gums when market conditions become normal, their chemical properties will be reviewed.

Starch is obtained from many different sources, and the products vary considerably in properties. The empirical formula is $C_6H_{10}O_5$, but this formula covers widely different carbohydrates.

According to Thomas' starch granules consist of two kinds, one of which is water-insoluble and known as α-amylose, the other being water soluble, and called β-amylose. Starches from different sources differ in their



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relative proportions, as shown in the table below:

Starch—	α-Amylose (%)	β-Amylose (%)
Corn	15	85
Rice	18	82
Potato	3 (?)	97
Wheat	23.5	76.5
Cassava (tapioca)	16.5	83.5

"Soluble starch" as the term is used here, refers to a dispersible material, rather than one which goes into true solution. In drilling fluids it is only the dispersible variety which is of value, so that our interests are limited to β-amylose. Taylor and Iddles[10] found that soluble starches do not migrate in an electric field, indicating that swelling and not electrical stabilization is involved in starch suspensions, and accounting for the lack of effect of salts on starch-base drilling fluids.

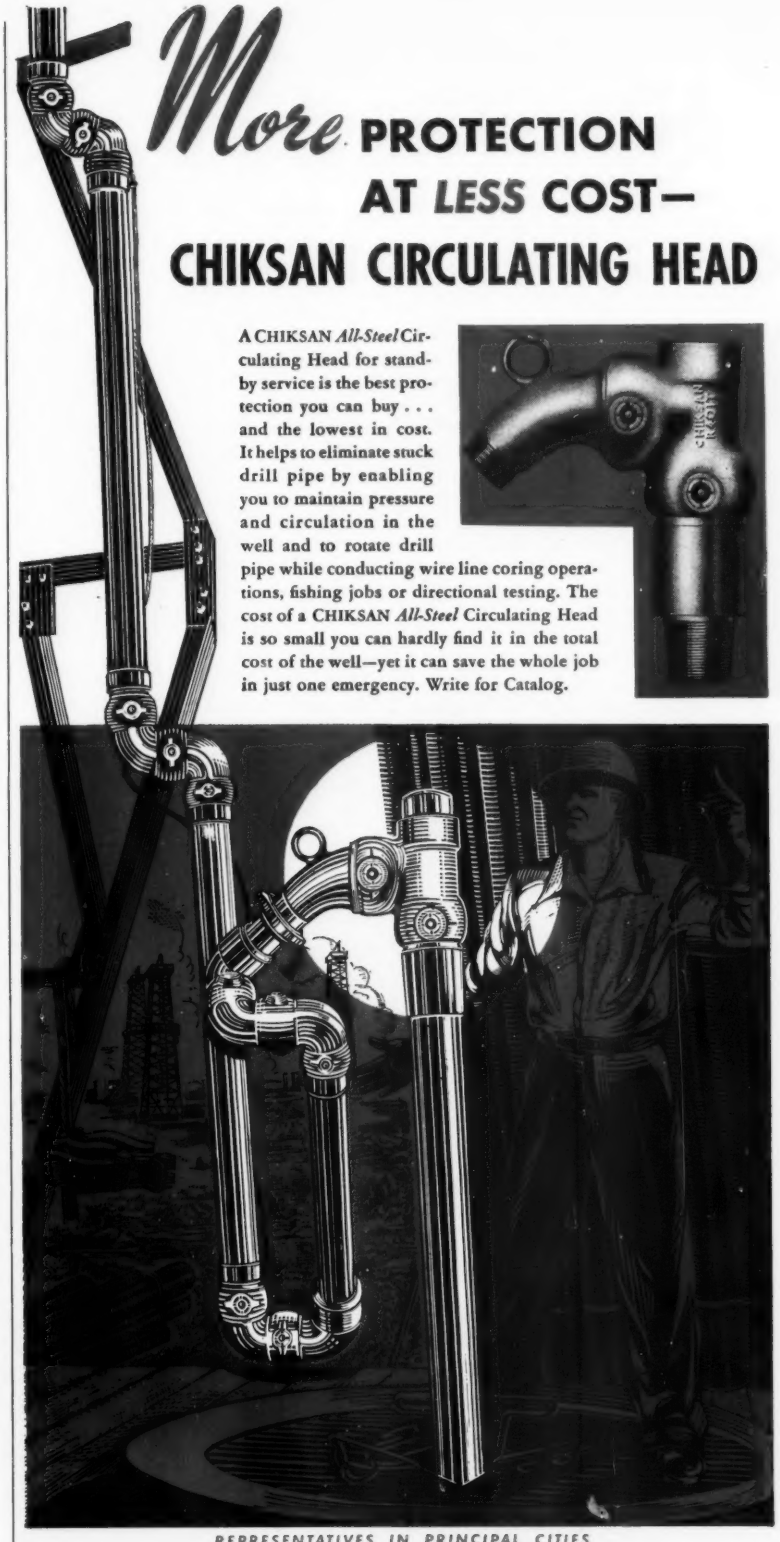
As starch comes from the plant, it is normally in the form of cells, which are covered with a tough membrane, which must be removed by grinding or boiling before the starch may be dispersed. Once the skin is disrupted, starches undergo reversible swelling in a manner similar to bentonite, in either hot or cold water.

Considerably less information is available in regard to the chemistry of gums than that of starches. Ordinarily, gums are natural mixtures of potassium, calcium and magnesium salts of carbohydrate acidic bodies, which show anodic electrophoresis, which gives them considerable dispersing and viscosity-reducing power in low concentrations. (See Fig. 4.) At higher concentrations they exhibit marked suspending power, which is not interfered with by salts such as NaCl and $CaCl_2$ encountered in drilling. Karaya gum is distinctly acid, giving off the odor of acetic acid, and is destroyed by highly alkaline solutions. Ghatti gum is more stable, and contributes more to lowering the filtrate and less to suspending the solid particles. Both the latter gums are particularly valuable in the formulation of drilling fluids of high salt content.

Mention should be made of agents which assist in the release of gas bubbles, by concentrating in the interface between liquid and gas, and thus cure the difficulty known as "gas cutting." A number of materials are effective for this purpose, notably alcohols, acetone and other light solvents.[11] Other compounds, such as higher alcohols[12] and fatty acids[13] may be used for the same purpose.

Oil-Base Muds

Water has a tendency to cause shales to heave, i.e., to sluff and bridge the hole, during drilling and to swell clays in producing formations, resulting in a considerably reduced permeability and thus lower productivity of the pay sands. Oil is inert to most clays and shales, and its use as a base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for drilling fluid is increasing even though the cost per barrel is generally considerably higher than for water-base muds of comparable properties. In place of bentonite, starch or gums as a stabilizing agent, soaps[14], lamp black[15] or asphaltic material[16] has been employed, with resulting filtrates of a very low order, frequently less than 1 cc. in 30 minutes.

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2. Harth, U. S. Patent 1,991,637 (1935).
3. Lawton, Loomis and Ambrose, U. S. Patent 1,999,766 (1935).
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12. Barnes, U. S. Patent 2,209,591 (1940).
13. Jones, U. S. Patents 2,271,695-6.
14. Rolshausen and Bishkin, U. S. Patent 2,099,825 (1937).
15. Henkes, U. S. Patent 2,222,949 (1940).
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Tests Show Diesel Trains Safe in Longest Tunnel

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The study was made at the request of the railroad company during the war when the use of diesel locomotives on the division that includes the Cascade Tunnel in Washington State was under consideration as an added means of handling the abnormal tonnage of wartime freight. Determination of the air contamination by exhaust gases was important because the tunnel was built for an electric haulage system and lacked equipment for mechanical ventilation. The test locomotive, the bore and grade of the tunnel, and the tonnages moved were comparable to those of other roads.

Summarizing the results of the investigation, L. B. Berger, bureau chemist at Pittsburgh, Pa., and L. H. McGuire, engineer-in-charge of the bureau's safety division office at Seattle, Wash., stated that the concentrations of CO_2 detected following passage of a diesel locomotive through the tunnel were not considered hazardous, nor was the oxygen content of the tunnel air depleted to a significant degree. The wake of smoke and gases some 20,000 ft. in length definitely reduced visibility in tunnel.

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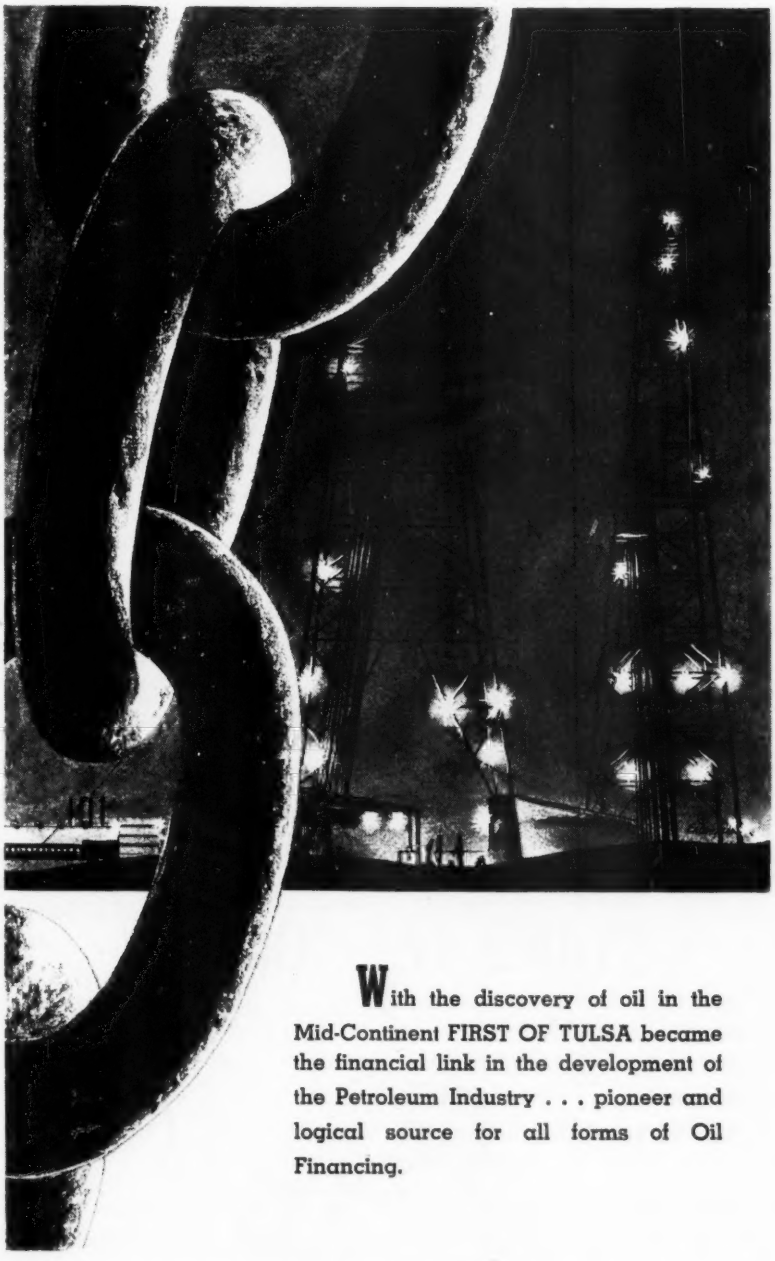

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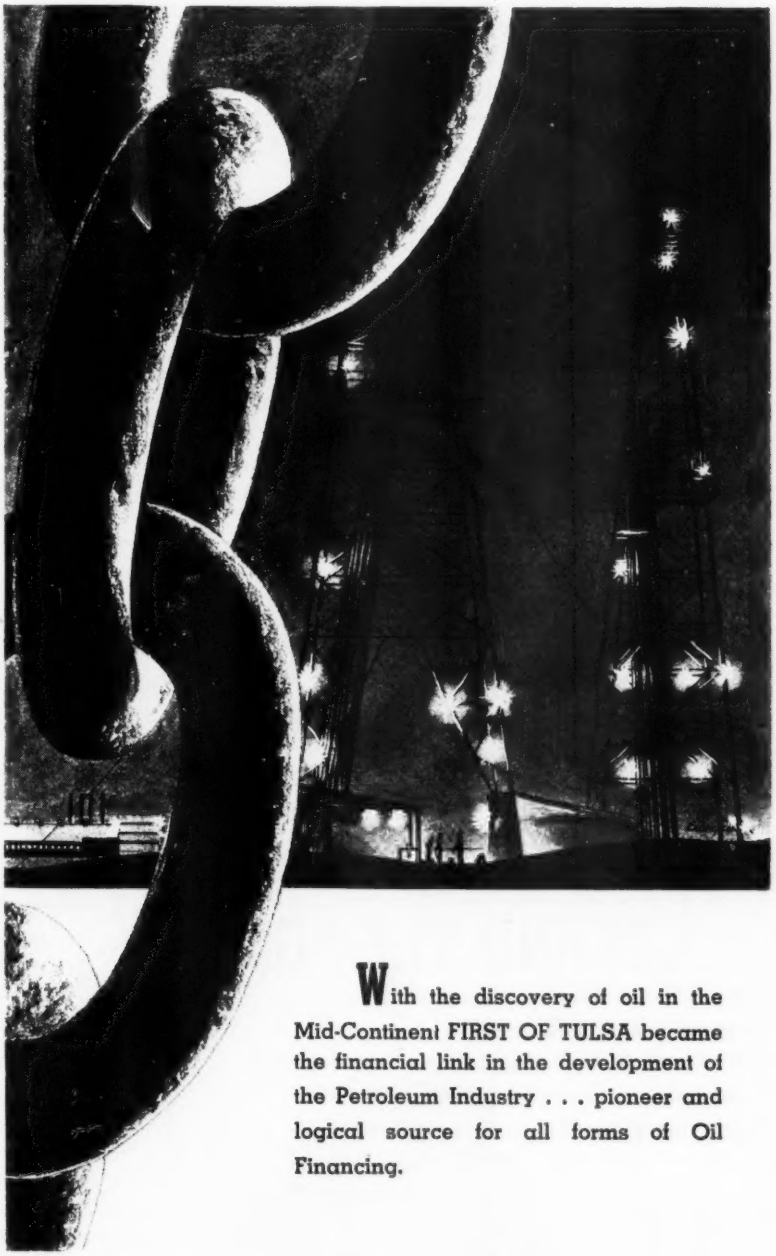

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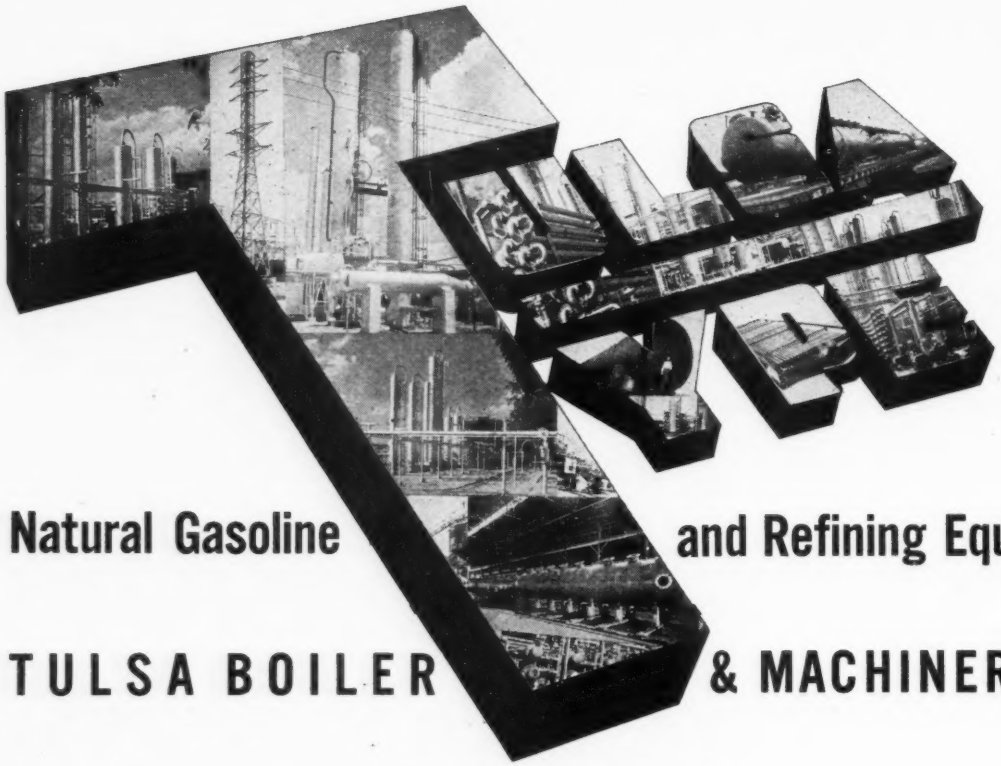

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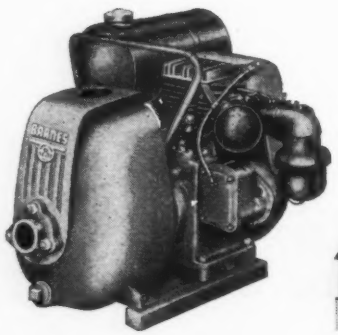

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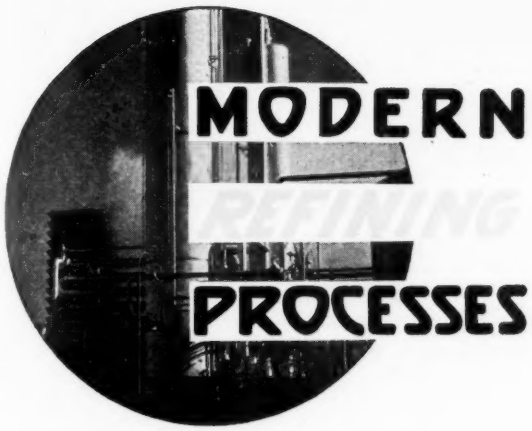

The Gas Reversion And Polyform Processes

by George Armistead, Jr.

THE use of the gas-reversion or "polyforming" process in connection with the thermal reforming of straightrun naphtha has found considerable acceptance as a means of increasing the attainable yields and octane numbers, and a substantial amount of capacity is in operation. In addition, the use of a similar operation in connection with viscosity breaking and gas-oil cracking has also achieved an important extent of commercial use for the same general purposes. According to published information,[5] the gas reversion or polyforming processes are currently employed by 6 refiners in a total of 17 units.

The gas-reversion or polyforming operation as usually practiced is a high-pressure coil-only thermal cracking operation in which a stream of C_3 and/or C_4 hydrocarbons (either produced in the operation or from outside sources) is introduced to the cracking zone along with the oil undergoing treatment, for the purpose of:

1. Effecting polymerization of the C_3 and C_4 hydrocarbons to others of gasoline boiling range.

2. Effecting alkylation and other interaction between the light stream and the oil undergoing cracking, including reactions such as cyclization.

3. Dilution of the heavier oil undergoing cracking, so as to permit more severe conditions and increased extent of conversion.

A DISTINCTION is made between the terms gas reversion and polyform, in referring to the processes involved. In gas reversion the light hydrocarbons are cracked before being mixed with the heavier charge; in polyform operations the light and heavy charges are mixed and heated together in the same zone. Severe gas reversion is applicable especially to the cracking of catalytic cycle oils. Justification for polyform and gas reversion depends largely on local butane and volatility balances; availability of extraneous charge materials is very important in the economics of these processes.

The processes have been described in considerable detail in the literature[1,2]. A distinction is drawn between gas reversion and polyforming, the former term being applied to the operation wherein the light hydrocarbon stream is separately cracked, in part, before being mixed with the partially cracked stream of heavier material, whereas the latter term applies to an operation wherein the light and heavy stocks are initially mixed and thereafter passed through the conversion zone.

Fig. 11-1 illustrates the conventional polyforming operation employed on naphtha. Here, the fresh feed is introduced into the high-pressure absorber where it may effect the recovery of the desired amount of butane-butylene present as well as considerable portion of the propane-propylene, and the thus-enriched naphtha is passed to the cracking or polyforming coil. In this coil, temperature conditions up to 1150° and pressures normally up to 2,000 lb. are generally employed with reaction times of the order of 0.05 and 0.08 cu. ft. of coil volume per barrel per day naphtha throughput. The furnace-coil discharge, after quenching, is subjected to fractionation, separating the small amount of polymerized tar and taking the gasoline and gas into a stabilization and absorption section. In the stabilization and absorption section, control may be exercised over the amount and character of light hydrocarbons recirculated to the furnace coil with the naphtha feed. Retention of butane in the stabilized gasoline affects the butane content of the absorber feed gas and consequently affects butane available to return to the cracking zone in composite furnace feed which is taken from the absorber base. Absorber conditions control the amount of propane-propylene retained by heater feed in the absorber base.

In ordinary naphtha polyforming operation, the ratio of total heater feed to virgin feed introduced to the absorber may be in the neighborhood to 2.5 to 1.0, the large increase in recirculation being due to the comparatively low conversion or disappearance of the recirculated light hydrocarbons per pass which is nec-

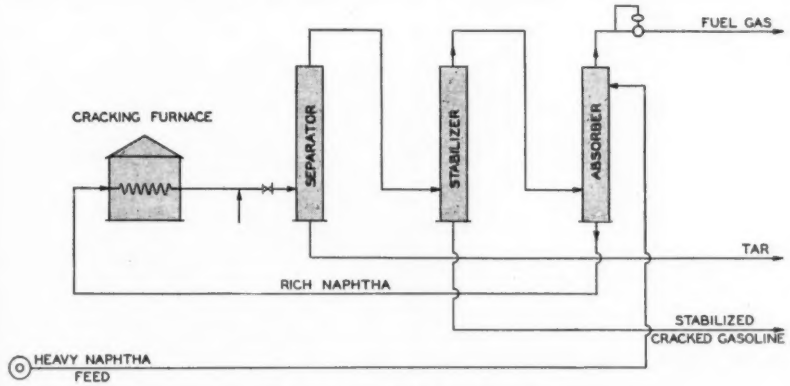

Fig. 11-1.—Naphtha polyforming

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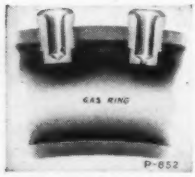

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essary in order not to exceed the permissible cracking of the heavier oil. The furnaces, as well as the fractionating and other equipment, must consequently be adequate for this duty.

The recycle ratios on the composite stream are governed largely by the individual conversion characteristics of propane and butane. Thus, the recycle ratio goes up markedly with the inclusion of propane in the recirculated light hydrocarbons, requiring recycling some 7-10 times the volume supplied in comparison to a corresponding recycling of only 3-5 times the volume supplied in the case of the less refractory butane[2]. The olefins react more readily than do the paraffins, with correspondingly lower recycle ratios. Although they are difficult to exclude entirely methane and ethane are very stable and are consequently undesirable to include in the light hydrocarbon recirculation, since they are productive of very little yield and require furnace coil and fractionating capacity as well as fuel consumption.

Recycle ratio is also related to the obtainable ultimate yield from the light hydrocarbon recycle and the oil undergoing cracking, the increase in recycle ratio giving increase in ultimate yield, but lower resultant octane level, because of reduced severity and conversion per pass. The following table from Fig. 2 of Bogk, et al[2], illustrates this effect on propane and butane.

	Ultimate vol. % yield 400 e.p. debut. gasoline			
	Propane		n-Butane	
Recycle ratio	1,500 lb.	2,500 lb.	1,500 lb.	2,500 lb.
1	23	24	34	36
2	27	29	39	41
3	31	33		45
4		36		49

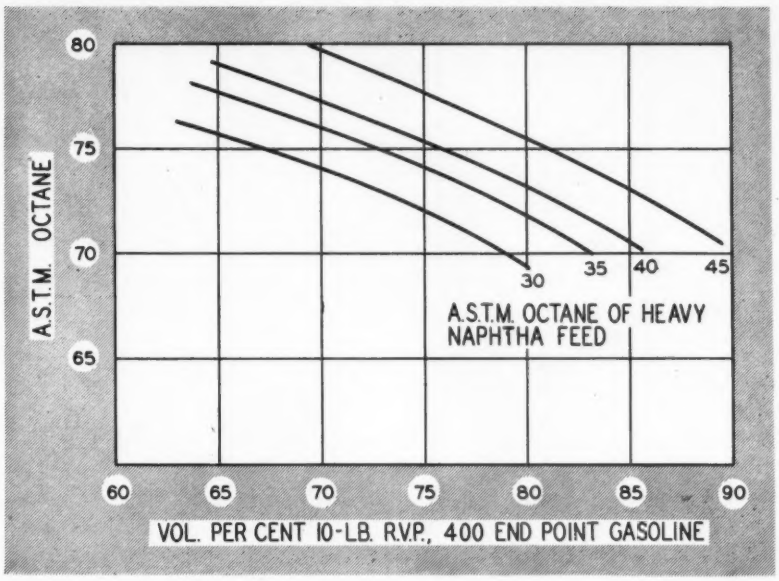

Fig. 11-3.—Trend of gas-reversion yields, various straightrun naphthas; 100 per cent recovery C_3 and C_4

Pressures in excess of 1,000 lb. are usually employed in the gas-reversion and polyforming operations, since the higher pressures are an aid to polymerization of olefins formed and are also conducive to alkylation and other reactions between the lighter and heavier hydrocarbons, as well as being of assistance in maintaining the phase relations of the composite stream unfavorable to the separation of tars which will readily coke.

The employment of the gas-reversion type of operation in connection with gas-oil cracking and viscosity breaking is similar to that on naphtha reforming and is illustrated in Fig. 11-2. In this operation, the process is reported to find much of its utility in the increased cracking per pass (basis heavy oil) where the heavy oil, such as gas oil or reduced crude, is diluted with the lighter hydrocarbons and limitations of coking and other effects are retarded. This, as in the case of naphtha polyforming raises octane number of the thermally cracked gasoline as well as effecting the conversion of the light hydrocarbons to gasoline. Fig. 11-2 illustrates a combination unit employing naphtha reforming, single-pass viscosity breaking, and gas-oil cracking. The light hydrocarbons are recovered for the reforming coil as described previously, whereas the C_3-C_4 cut used in the other coils may be separated as a condensate from the

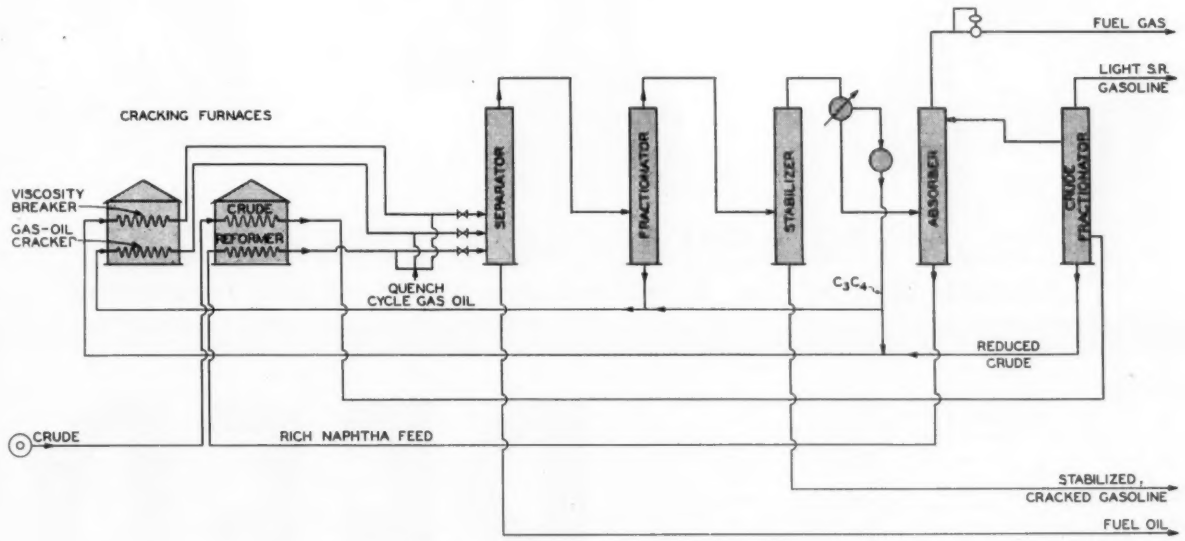

Fig. 11-2.—Combination crude and gas-reversion cracking unit

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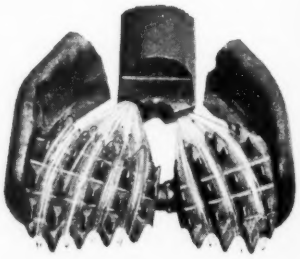

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stabilizer overhead and pumped directly to those coils, as mentioned in the foregoing. Cracking-coil pressures in excess of 1,000 lb. and up to 3,000 lb. are generally employed for such operations along with temperatures up to 1,100° F. For the recovery of the desired light hydrocarbons, the fractionation system operates at 250 to 400 lb. The dilution ratio (heavy oil feed : recirculated C_3 and C_4) customarily employed is in the range of 1 to 1.5.

The ultimate results of any gas-reversion operation, either for naphtha reforming, gas-oil cracking, or viscosity breaking obviously depends to a large extent upon the recovery of the C_3 and C_4 hydrocarbons from the product gas stream. The recovery of the majority of the butane-butylene cut for return to the coils is practical and can be done without excessive expenditure of materials. The recovery and return of propane-propylene in corresponding percentage presents a much more difficult problem, however. It has been generally indicated that the ultimate gasoline yield in a naphtha polyforming operation was substantially greater than is obtainable by high-pressure naphtha reforming in combination with thermal polymerization of the total C_3 and C_4 fractions[2], when running to the same octane level. Such comparisons were necessarily made on the basis of equal recoveries of C_3 and C_4 hydrocarbons, which have an important effect on the economics of the whole operation including initial cost of equipment and operating cost. There have been other indications that on comparable bases the yield-octane relationships of gas reversion as compared to reforming plus thermal polymerization are not radically different although slightly in favor of gas reversion.

Fig. 11-3 shows the trend of yield-octane relationships for a variety of low-octane heavy naphthas when effecting the maximum obtainable recovery of C_3 and C_4 hydrocarbons and recycling these hydrocarbons to extinction. Operations involving lower recovery of the light hydrocarbons will give somewhat lower and flatter curves. Progressively decreasing the recovery makes the operation approach a straight naphtha reforming operation, or in the case of a gas-oil reversion operation, a straight gas-oil cracking operation is approached.

The mechanism of the gas-reversion processes, as in all severe thermal cracking operations, involves, in addition to the polymerization and condensation reactions on the lighter hydrocarbons, the formation of certain aromatic compounds which are partly responsible for the octane quality of the product. These aromatic materials including toluene and xylenes have also been produced in sufficient quantity to warrant commercial separation of the individual compounds. The high-severity gas-reversion operations are reported to be especially applicable to refractory catalytic cycle gas oils, when it is economic to thermally crack such stocks.

An attractive feature of gas reversion has been its adaptability to the conversion of extraneous C_3 and C_4 stocks along with a cracking operation. Such an operation is carried out essentially as described in the foregoing except that additional facilities may be required for the separation of the C_3 and C_4 fractions from an available feed stream such as gas. The justification of polyforming or gas reversion for any given refinery depends to a considerable extent on the local butane and volatility balance which determines the amount of butane available for such conversion. The availability of extraneous materials may be of importance in this regard. Since the war, the presence and use of a large amount of catalytic-cracking capacity which produces C_4 fractions consisting largely of isobutane and butylene, which is usable directly along with propylene in the abundant alkylation capacity, has not been favorable to the extension of use of gas reversion in connection with gas-oil cracking. Nevertheless, thermal naphtha reforming is still widely practiced on straightrun gasoline and while such operations cannot be considered singly in a large refinery, they may present substantial advantages for polyforming, particularly in refineries having little or no catalytic cracking capacity, or alkylation facilities. Extraneous supplies of normal butane, depending on the character and disposition of the refinery butane-butylenes, may also make some of the gas-reversion operations attractive.

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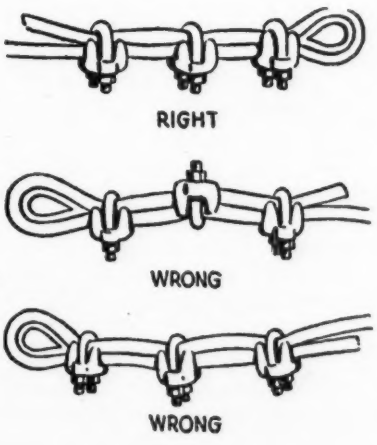
Installing Wire-Line Clamp

by Henry W. Boggess*

THE U-bolt type of wire-line clamp is universally used in oil fields. There may be many jobs on which it is not essential to install these clamps so that they will insure maximum strength and service. On the other hand, there are many wire lines used in oil-field work that require the use of clamps and where it is necessary that maximum strength be maintained. On such jobs, it is important to understand the proper way to install U-bolt clamps. The accompanying illustration shows the correct installation contrasted with two wrong installations.

*Superintendent of personnel department, Sinclair Prairie Oil Co.



To get a fixed impression of the right way to apply U-bolt clamps, it is necessary to understand that the total stress applied when the nuts are tightened is equally divided between the U-bolt part of the clamp in contact with the line and that part of the base in contact with the line. Since the area of the base is many times greater than that of the U-bolt, the base is less likely to injure the line. Therefore, the base should always be in contact with the line which takes the pull.

Another type of wire-line clamp is commonly referred to as "inverted end clip." The principle of this clip is to equalize the bite of both parts of the clip that contact the line.

QUESTIONS on TECHNOLOGY

by W. L. Nelson
Consulting Engineer

Bunker Fuel-Oil Specifications

Do the old specifications of 1931 still apply to Bunker A, B, and C fuel oil? Question arises as to whether or not the viscosity standards have gone unchanged for 15 years or more.—E. C. W.

Records of the formal action of discarding name Bunker A, B, or C are not available to this department but it appears to have occurred about 1933. Undoubtedly one reason for dropping the name "Bunker" was the fact that it inferred that such oils were only suitable for the fueling of ships whereas the same fuel oils are used for many industrial purposes. Our available history is as shown in the accompanying tabular information:

1933—C.S. 12-33 NATIONAL BUREAU OF STANDARDS

	Flash, min. (°F.)	Water and sediment (per cent)	Viscosity, max. Univ. @ 100° F.	Viscosity, max. Furol @ 122° F.
No. 4	150	1	100	...
No. 5—also Bunker B Fed. Spec. 2d.	150	1	...	100
No. 6—also Bunker C Fed. Spec. 2d	150	2	...	300

1936—C.S. 12-37 NATIONAL BUREAU OF STANDARDS

	Flash, min. (°F.)	Water and sediment (per cent)	Ash (per cent)	Viscosity Univ. at 100° F.	Viscosity Furol at 122° F.
No. 4 low viscosity	150	1	0.1	55-250	.....
No. 5 medium viscosity	150	1	0.15	250	100 max.
No. 6 high viscosity	150	2	...	.....	100-300

1938—COMMERCIAL STANDARD C.S. 12-38 NATIONAL BUREAU OF STANDARDS

	Flash, min. (°F.)	Water and sed., max. (per cent)	Ash, max. (per cent)	Viscosity Univ. at 100° F.	Viscosity Furol at 122° F.
Fuel oil No. 5	130	1	0.1	60 min.	40 max.
Fuel oil No. 6	150	2	...	.....	45-500

1940—C.S. 12-40 NATIONAL BUREAU OF STANDARDS

	Flash, min. (°F.)	Water and sediment (per cent)	Ash (per cent)	Viscosity Univ. at 100° F.	Viscosity Furol at 122° F.
Fuel oil No. 5	130	1	0.1	50 min.	40 max.
Fuel oil No. 6	150	2	...	.....	45-300

1918—U. S. NAVY SPECIFICATIONS FOR NAVY PETROLEUM

1. Flash point—150° F. minimum (Abel or Pensky-Martens), or
   Flash point—175° F. minimum (Tagliabue open cup), and
   Flash point (closed cup)—150° F. or the temperature at which the oil has a viscosity of 8° Engler.
2. Viscosity—40° maximum Engler at 70° F.
3. Sulfur—under 1.5 per cent.
4. Sediment and water—under 1 per cent.

An 8° Engler oil has a Saybolt time of 300 seconds, and a 40° Engler oil has a Saybolt time of 1,500 seconds. It is interesting to note that this very early specification ties the flash point to the temperature to which the oil must be heated in order to be properly fluid.

1918—OCTOBER 2—BULLETIN 1—U. S. FUEL ADMINISTRATION OIL DIVISION

Bunker oil "A"—Same as Navy specification fuel oil except no limit on sulfur.

Bunker oil "B"—Flash point—150° F. minimum (Pensky-Martens or Abel), or
Flash point—175° F. minimum (Tagliabue open cup)
Gravity—18° Be. minimum
Water and sediment—under 1 per cent

Bunker oil "C"—Same as Bunker oil "B" except the approximate gravity will be 16° Be.

1920—DECEMBER 29—BULLETIN 5—U. S. BUREAU OF MINES

Fuel oil (Navy standard):
Same as 1918 specifications except that the Saybolt Furol viscosimeter was adopted.
The Furol viscosity of 140 sec. @ 70° F. is the same as 40° Engler @ 70° F.

Bunker fuel oil "A":
Same as 1918 except the viscosity was changed to 30 sec. (maximum) Furol @ 150° F.

Bunker fuel oil "B":
Flash point—150° F. minimum (Pensky-Martens closed cup).
Viscosity—100 sec. maximum @ 122° F. (Furol).
Water and sediment—1 per cent.

Bunker fuel oil "C":
Flash point—150° F. minimum.
Viscosity—350 sec. maximum (Furol) @ 122° F.
Water and sediment—1 per cent maximum.

1927—U. S. BUREAU OF MINES T.P. 323B

	Flash, min. (°F.)	Visc. Furol, max.	Sulfur, max. (per cent)	Water and sediment, max. (per cent)
Navy specifications	150	100 @ 77° F.	1.5	1
Bunker A	150	100 @ 77° F.	...	1
Bunker B	150	100 @ 122° F.	...	1
Bunker C	150	300 @ 122° F.	...	2

The late Dr. C. K. Francis in The Oil and Gas Journal of July 26, 1934, states that the above specification was obsolete and was being replaced.

The specifications have remained the same since 1940.

It is believed that Bunker A, B, and C went out of existence as formal names in about 1933 although less well-known specifications may still carry the names. Although the name Bunker C is still widely used in the industry, it undoubtedly refers to No. 6 A.S.T.M. or Commercial Standards fuel oil. In summary, the viscosity specifications have varied as follows for heavy fuel oil:

Designation	Vis. character
1918 Bunker C	150 Furol @ 77°
1920 Bunker C	350 Furol @ 122°
1927-33 Bunker C	300 Furol @ 122°
1936 No. 6 fuel	100-300 Furol @ 122°
1938 No. 6 fuel	45-500 Furol @ 122°
1940 No. 6 fuel	45-300 Furol @ 122°

Oxalic Acid as Additive

Can you tell us if oxalic acid has been used or is being used as a mineral-oil additive in this country?—T.G.M.

Such an enormous number of materials have been proposed, mentioned in patents, or have been used as lubricating-oil additives that much time would be required to specifically answer the question.

Dicarboxylic or dibasic acids, of which oxalic acid is a typical example, have long been recognized as additive agents. Particularly, succinic acid, $C_2H_4(COOH)_2$, has been mentioned. It must be pointed out that these materials are not directly suitable as additive agents. It is necessary to attach long side chains of an aliphatic nature to gain adequate solubility. Thus, the problem of developing an additive is not so much one of finding a suitable base material as it is to learn how to cheaply synthesize the very high-molecular-weight (several hundred) type of derivative that is compatible with lubricating oil.

EFFICIENCY OF WATER DRIVE

. . . in Illinois Sand Reservoirs

by A. W. Baucum and W. D. Steinle**

THE detailed subsurface studies of five water-drive reservoirs in Illinois serve as a background for the information and conclusions presented in this article. Core analyses, electrical logs, subsurface sample analyses, and production performance histories provide the basic data available for each reservoir. Well densities, rates of withdrawal, characteristics of the reservoir media, and properties of the reservoir fluids were studied to determine their effects upon recoveries.

Ultimate recoveries estimated from these pools, all of which are nearly depleted, range from 400 to 482 bbl. per acre foot. This is equivalent to from 50 to 57.7 per cent of the tank oil originally in place. These are relatively high recoveries from Illinois reservoirs and the study of these five pools should therefore prove of practical interest.

The purpose of this article is to present results of the analysis of these reservoirs as an addition to the background of reservoir performance, which background is necessary to determine the number of wells which should be drilled and to insure proper production practices.

*The Texas Co.

Five Illinois oil reservoirs are here critically examined as to their character, their performance, and as to the efficiency of recovery achieved by the natural water drives present. The paper is quite compact, purposely, but was built up from a very large amount of data and performance records available to the authors. From Mid-Continent district A.P.I. meeting, division of production, Oklahoma City.

Structural Features

In Table 1 are outlined the structural features of each of the five fields. They vary in productive area from 570 up to 1,800 acres, and have gently sloping flanks and low structural relief. The shapes of the reservoirs range from domal to elongated anticlinal with a longitudinal axis three times the length of the transverse axis.

The presence of considerable structural relief is usually considered responsible in a large degree for efficient water drive and high ultimate recovery. Large relief insures better control of the advancing water front, reducing the tendency toward coning, channeling, and bypassing by affording a better opportunity for the desired gravitational segregation of the oil and water within the reservoir.

The low closures of 20 to 50 ft. leave permeable water sand underlying the oil-bearing sand throughout most of the productive area of each of the five pools. In clean sands this would tend toward early water coning, resulting in the early abandonment of wells and low recoveries. A withdrawal rate sufficiently low to prevent water coning would be too low to result in an operating profit.

The fact that relatively high recoveries were obtained from these reservoirs must therefore be attributed to other factors.

TABLE 1

Reservoir	Approximate areal extent, acres	Average pay thickness, ft.	Productive closure, ft.	Shape factor*
No. 1	570	16.8	50	1/1
No. 2	570	9.6	20	3/1
No. 3	1,240	12.5	30	3/1
No. 4	1,350	8.2	25	3/1
No. 5	1,800	13.4	38	1.5/1

*Ratio of major to minor axis.

Characteristics of Reservoir Media

The reservoir media of these five pools consist of relatively well sorted sands, laminated with shale, silt, and calcareous materials which limit the vertical permeability. These laminae are evident from visual examination of most cores, but generally they cannot be detected from electrical logs or from core-analysis profiles showing only horizontal permeability and porosity.

The fact that water coning did not occur in these pools is probably attributable to the lack of continuity in vertical permeability due to the presence of these laminae. The advancement of edgewater was predominantly parallel to the bedding planes, with the uniformity of encroachment dependent almost entirely upon the uniformity of lateral permeability. Although edgewater did channel through to some of the wells through more permeable strata, the effect was not sufficiently great to seriously reduce ultimate recovery.

Table 2 summarizes average values for horizontal permeability, porosity, and interstitial water saturation for each of the five pools.

TABLE 2—CHARACTERISTICS OF RESERVOIR MEDIA

Reservoir	Avg. permeability (Md.)	Avg. effective porosity (%)	Avg. interstitial water (%)
No. 1	104	17.9	40.0
No. 2	303	17.0	34.0
No. 3	95	15.3	26.5
No. 4	100	19.2	37.0
No. 5	186	19.6	36.0

Properties of Reservoir Fluids

Table 3 summarizes the characteristics of the reservoir oil for each pool. By comparing the saturation pressure and original reservoir pressure it will be noted that all five reservoir oils were undersaturated originally. The solution gas was as low as 8 cu. ft. per bbl. of stock-tank oil for three reservoirs. The other two reservoirs contained substantial quantities of gas in solution. The performance histories

TABLE 3—CHARACTERISTICS OF RESERVOIR OIL

Reservoir	Original reservoir pressure, psi.	Orig. sat. press., psi.	Shrinkage factor	Gas in sol. cu.ft./bbl. of stock-tank oil	Viscosity in centipoises: Reservoir press.	Viscosity in centipoises: Atmos. press.
No. 1	425	199	.965	8	5.20	5.65
No. 2	710	100	.983	8	3.63	4.12
No. 3	1,000	660	.850	280	2.0	4.0*
No. 4	1,050	740	.850	320	2.0	4.0*
No. 5	500	100	.983	8	4.4	4.9*

*Estimated.

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of reservoirs Nos. 1, 2, and 5 were substantially different from that of Nos. 3 and 4, because of this large difference in the amounts of gas contained in solution.

The production-performance curves of reservoirs Nos. 3 and 4 reflected an initial flush-production period during which the subsurface pressure showed a rapid decline, while the gas-oil ratios showed a marked increase. This performance is typical of reservoirs producing by dissolved gas drive. The flush production was followed by a longer period, where the pools produced by a combination of gas expansion and water drive. During the early part of the second stage of production, wells around the perimeter of the structure showed sustained production, while the production from wells in the center of the group continued to decline. Current production performance indicates that pressure has declined to a point where these fields now are producing and will continue to produce under water drive, with the reservoir pressure remaining relatively constant at a low value.

The production performance of reservoirs Nos. 1, 2 and 5, were found to be entirely different from those of reservoirs 3 and 4. There was no period of flush production wherein the gas-oil ratios rose markedly, indicating that the pools were under water drive throughout their producing life. The produced gas-oil ratio remained near the solution gas-oil ratio and did not exhibit the trend shown by reservoirs 3 and 4. These pools also are currently producing under water drive with reservoir pressure remaining at a low constant value.

Recovery Factors

The ultimate recovery from each of the five reservoirs is set out in Table 4. Recoveries are expressed in terms of barrels per acre foot, percentage of void space (porosity), percentage of tank oil originally in place, and the percentage of "theoretically recoverable" tank oil in place. These various expressions of recovery may be used to compare the efficiency of recovery from one reservoir with the efficiency of recovery from any other reservoir. In our opinion the most accurate index of the efficiency is shown in Column 5, the percentage of recoverable tank oil.

The methods of expressing recoveries shown in Columns 2, 3, and 4, are familiar. Column 5 requires explanation. It denotes the percentage actually recovered of the oil theoretically recoverable, provided there was complete invasion by water with no bypassing or trapping. This factor serves as an indication of the amount of reservoir space which actually was flooded by invading water.

When samples of cores from these pools are flooded in the laboratory with water, the oil saturation is rapidly reduced to a value of approximately 20 per cent of the porosity. At this saturation, the effective permeability to oil becomes very low and the effective permeability to water very high so that little oil can be recovered by passing large volumes of water through the core. The oil remaining must therefore be considered non-recoverable by water-drive. The amount of non-recoverable oil in laboratory tests is inversely proportional

TABLE 4—RECOVERY FACTORS

Reservoir	Avg. init. prod. per well	Ult. rec. bbl./ac. ft.	Recovery factors based upon various terms: Per cent void space	Per cent tank oil orig. in place	Per cent theoretically rec. tank oil in place
No. 1	146	429	30.9	53.4	81.6
No. 2	155	430	32.7	50.2	76.0
No. 3	193	428	36.1	57.7	84.7
No. 4	241	400	26.9	50.2	80.2
No. 5	131	482	31.7	50.4	81.5

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to the viscosity of the oil. However, the viscosities (Table 3) of oil in the five pools studied are approximately the same at atmospheric pressure (corresponding approximately to abandonment conditions) and the effect of this factor need not be considered here.

As the reservoir pressure in these pools has declined to a very low value, the shrinkage factor approximates 1.00. Using the residual (non-recoverable) oil saturation, a shrinkage factor of 1.00, and the porosities shown in Table 2, the amount of non-recoverable oil expressed as barrels per acre foot can be computed. Using the porosity and interstitial water contents from Table 2 and the original shrinkage factor from Table 3, the amount of stock-tank oil originally in place can be calculated. The difference between these two values is then the theoretically recoverable oil. The actual recovery divided by the amount theoretically recoverable is, therefore, an index of the "efficiency of recovery." Table 4 shows that this efficiency varied from 76 per cent for reservoir No. 2 up to 84.7 per cent for reservoir No. 3, there being no significant difference between values for reservoirs Nos. 1, 4 and 5. As a matter of fact, the variation of the lowest to the highest recovery figure is probably within the error in estimating sand thickness, productive area, porosity and interstitial water for each reservoir.

The influences of shrinkage factor and interstitial water saturation upon recovery have been eliminated by the method of calculation described above. Any difference in efficiency between fields must therefore lie in the effects of differences in average permeability, producing rate, or well density.

That average permeability does not appear to be responsible is evident from an inspection of Table 2, wherein it is shown that reservoir No. 2 has a permeability three times as high as that of reservoir No. 3, whereas the recovery percentage was lower for No. 2. This relation is contrary to that generally observed.

Reference to Table 1 indicates that structural features had no effect, as is shown by comparison of reservoirs Nos. 1, 4, and 5, which had the same recovery for markedly different structural features. It therefore remains to discuss the possible effect of producing rate and well density upon the recovery efficiency.

Producing Rate

Usually it is conceded that restricted rates of oil withdrawal result in a higher ultimate recovery from water-drive pools. This is for two reasons: first, the rate of advancement of encroaching water may be more nearly the same for layers of difference permeability at low rates of advance; and second, low rates of oil production allow the water to replace the oil as it is produced, resulting in maintenance of a higher reservoir pressure and consequently of a lower shrinkage factor.

Water encroachment into each of these five reservoirs was at such a low rate that it was not feasible to give consideration to the above two factors, and restrict production accordingly. However, the recoveries obtained are such as to indicate that Item 1 above was not of primary importance, and that serious bypassing did not occur. There is no question but that the change in shrinkage factor due to lowering reservoir pressure from its original value to that obtaining at the present time, resulted in loss of recovery. However, this loss was unavoidable due to the physical and economic factors involved.

Well Density

The location of producing wells with respect to structure and shape of the reservoir may have a marked effect upon the recovery efficiency. However, it is generally conceded that well spacing is largely a problem in economics, and the number of wells drilled should be such as to result in the highest net profit. In these five pools, the locations of wells were

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determined by property lines, and wells were drilled on regular spacing pattern presumably to insure equitable recovery under the law of capture. The average spacing was set by the first few wells drilled in each pool. The average well densities varied from 9.6 up to 23.8 acres per well as shown in Table 5.

From the spacing-recovery data given in the above table, it is apparent that no increase in recovery is obtainable by merely increasing the well density. From the standpoint of ultimate recovery alone, it is indicated that reservoirs Nos. 2, 3, 4 and 5 were overdrilled.

While data on operating costs and decline rates during the flush production period are not available for a complete analysis to determine optimum spacing, general comments concerning current conditions in these reservoirs can be made.

TABLE 5—WELL DENSITY AND RECOVERY EFFICIENCY

Reservoir:	Average well density acres/well	Ultimate recovery per cent of theoretically recoverable oil in place
No. 1	23.8	81.6
No. 2	13.1	76.0
No. 3	9.6	84.7
No. 4	9.6	80.2
No. 5	10.0	81.5

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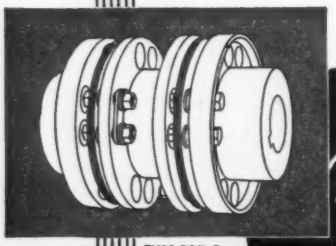

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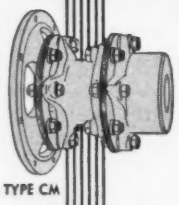

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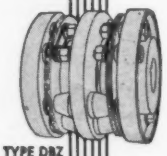

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Histories for reservoirs Nos. 2, 3, 4, and 5 indicate that the net profit was considerably reduced by drilling unnecessary wells. The operators in these pools would have realized more money if the initial spacing program had been sufficiently flexible to eliminate the necessity for drilling to an average well density of approximately 10 acres per well. It is our opinion that the results of the studies of these five pools can be profitably applied to newer discoveries in Illinois, and possibly in other areas wherein the reservoirs are of a similar nature. The original spacing programs in pools of this type should be 20 or more acres per well, and a closer spacing should not be adopted until it is shown that increased profits can be obtained by drilling more wells. The data from these fields shows that closer spacing does not result in increased recovery, and the drilling of more wells must be justified on some other basis such as increased rate of production.

U.S.G.S. Releases Data On Airborne Magnetometer

The United States Geological Survey has issued a report on the airborne magnetometer, entitled "Geophysical Investigations Preliminary Report No. 3—The Airborne Magnetometer," which discusses this new instrument, and includes maps made of part of the Alaskan Naval Petroleum Reserve No. 4; Iron County, Michigan; and a comparison set of maps around Mangum, Okla., including a ground station map, 300 ft. above the ground, 1,300 ft. above the ground, and 6,300 ft. above the ground. (See The Oil and Gas Journal, July 13, 1946, p. 80, for an authcritative article on operational procedures with this new instrument.)

"Packaged Power" features new Rig Design

by Kenneth B. Barnes

Crow Drilling Co. rigged up for the first hole for its new N-10 Brewster rig, the 1 Cush of Phillips Petroleum Co., approximately 10 miles northwest of Shreveport

ENGINEERS looking over the locomotives that pull the Santa Fe's Super Chief or the 20th Century Limited of the New York Central see in one place and under one cover all of the power equipment that makes those crack trains perform as they do. In one of these locomotives is found a complex but carefully engineered and interrelated compact group of machinery, including power plant, generators, controls, and other units performing many essential functions.

Something of this type of engineering design also is going into the new rotary drilling rigs now appearing for efficient use in both wildcat and development operations. Rotary rigs used to have, more or less scattered, a pump or two here, a draw works and rotary on the floor, and generators and other equipment some place else, but in all with little of the compactness and interfunctioning assembly of machine units found in the locomotives referred to above.

Illustrative of the trend toward increasing the efficiency and compactness of portable rigs, however, is the new N-10 rig that Brewster Co., Inc., of Shreveport, has recently constructed and put into operation for Crow Drilling Co. of Shreveport. Now in use in Caddo Parish in Louisiana, this rig combines many proven features with an unusual substructure and draw works assembly which makes drilling almost a "push button" affair.

At the Louisiana location (1 Cush, in Section 19-19n-16w, and owned by Phillips Petroleum Co.) Crow Drilling Co. is giving this rig its first-on-the-job test, and the performance reports are very satisfactory in all respects. Highspots of an inspection of the rig are those of the unity and compactness, or of what can be said to be the careful space-saving design. By constructing the substructure as part of the assembly, the mud house and dog house have been eliminated, and these sections, as well as the draw works, pumping unit, and power unit are consolidated so the rig can be easily dismantled and transported.

Portable Mast Good for 10,000 Ft.

Mast on the N-10 is 126½ ft. high, made of welded tubular steel, and is designed to drill to a depth of 10,000 ft. The mast is transported in two loads and is joined on the ground before raising. The pipe rack is raised with the mast. The drill pipe is racked outside the mast to allow working room. The Brewster crown block has five 36-in. flame-hardened sheaves, one of which is offset so that the fast line runs outside the mast. A four-sheave traveling block is used on 1 Cush, and the 22-in. oil-bath rotary table is set into the substructure floor. The rotary drive incorporates a Twin-Disc clutch with four speeds forward available, and two convertible to reverse speeds.

Height of the draw-works shell has been kept to 66½ in., and the driller

Behind driller T. B. Hill of Crow Drilling Co. is the control panel which commands operation of the entire rig

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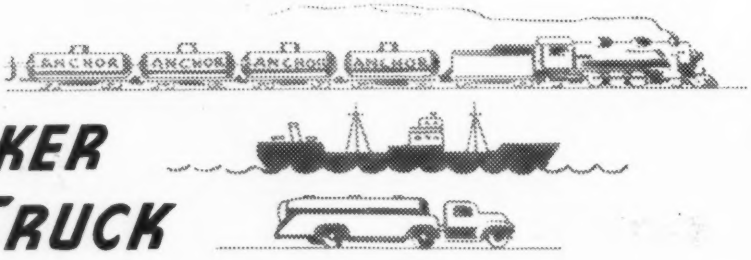

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has an unobstructed view of all operations. On the derrick floor a shipshape appearance prevails at all places. The drives are covered, safety handrails are installed throughout, and a control panel of gages and valves is set at the driller's eye level. This control panel is the center point of attention, as all drilling operations are controlled from it. All clutches are controlled by Westinghouse air valves, and oil, vacuum, and air gages are mounted above them on the panel.

The draw-works drum has eight speeds—four in the low-speed drum clutch, and four in the high-speed drum clutch—and is braked by full-wrap self-adjusting, self-equalizing brakes aided by a hydromatic brake. The transmission has been designed and built as an integral part of the draw works, eliminating that item as a separate unit. A "lockout" feature in the transmission prevents locking the draw works in more than one speed at a time, and all sprockets must be stationary before it can be shifted from one speed to another. Another development is the installation of the shafts so that each can be pulled independently from the assembly, without tearing down the entire draw works to effect overhaul. Roller bearings are used on all sprockets and shafts in the assembly. Twin-Disc friction clutches, as well as the Fawick air clutch, are mounted externally for accessibility for maintenance and servicing, as well as to provide air cooling. The transmission is lubricated by an oil pump, and clean oil is assured by a filter which is located so the cartridges may easily be changed.

The rig is powered by four 198-hp. Waukesha engines, each of which is equipped with an air compressor to maintain air for the brakes and clutches. Each engine is coupled to the chain box-type compound by a Fawick air clutch. Lubrication of the compound is obtained by the chains lifting oil from a bath and distributing it through pipes to a gravity feed system.

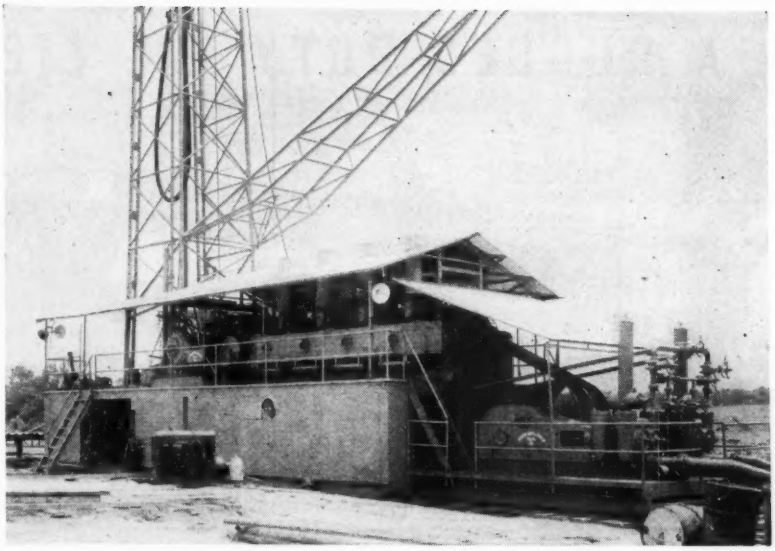
Housings in Substructure

One of the engines is ordinarily used to run the rotary, while the other three run the draw works and pumping unit, but all can be used for maximum power in pulling casing or drill pipe. The engines are synchronized by vacuum throttle control. The engines can be run on butane or on natural gas, the latter being used at the 1 Cush location. Two air-operated Foster friction catheads are incorporated in the assembly, mounted on the transmission output shaft, and give four speeds.

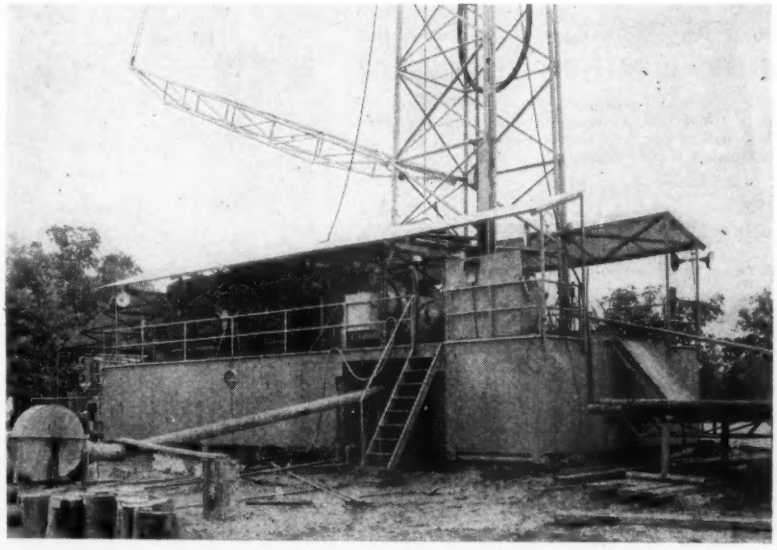
Electrical power for the rig is supplied by the main generator which runs off the engine compound, and an auxiliary generator is run off a 30-hp. engine. This engine is also used to operate one of the mud pumps at 15 s.p.m. for mud mixing. Weatherproof electrical power outlets are conveniently placed throughout the rig for the operation of floodlights or electrically operated tools. The generators are located in the substructure, along with the mud room and toilet and shower facilities for the drilling crew. Interior of this section is painted white to ease cleaning and is ventilated by exhaust fans to keep the mud room clear and to cool the crew rest room.

Crow Drilling Co. easily transported complete unit in nine truckloads. In addition to the two for the derrick, the substructure section requires three, the draw works and transmission one, the power unit one, and the pumping unit two. Each of these units is equipped with skids for ease in loading and unloading. As a unit the draw works and transmission weighs 46,400 lb., and the power unit weighs 42,400 lb. After unloading, the complete rig can be assembled in 4 or 5 hours, and drilling started 1 day after unloading has been accomplished.

The mast is raised by using the boom shown above the unit (see photographs).



Rear view of the new rig. The pumps, on skid, are driven from the engine compound. Safety rails surround all the units. The roofs are made of corrugated aluminum



Engine-side view showing the substructure housing. The generators are mounted underneath the left end and are accessible through the extreme left-hand door

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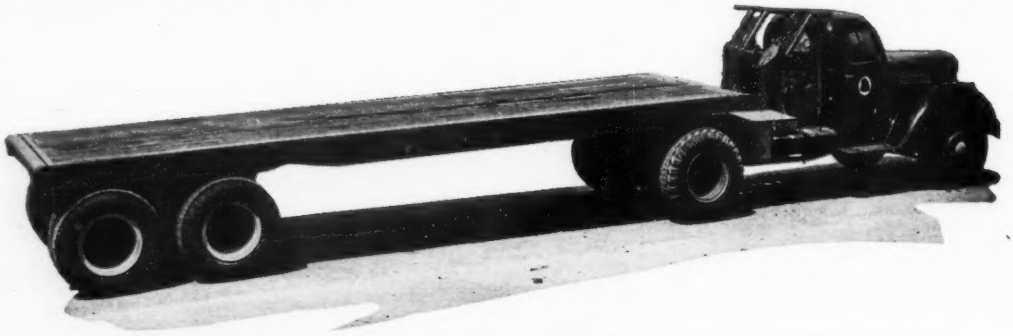

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Trigonometric Levels

STADIA surveying has many uses. For example, trigonometric levels can be run by stadia. The accuracy attained is much less than by direct leveling under usual conditions but the method is much faster. Suppose the difference in elevation between two points at a considerable distance apart, say 1,200 to 1,500 ft., is wanted. The transit can be set up somewhere between the two points, A and B (Fig. 2) and stadia readings taken, first with the rod at A, and then at B. The data would be reduced as in the illustration above.

Example: Assume that the following values were obtained for the condition pictured in Fig. 2. With rod at A, the intercept observed was 6.82 ft. at a vertical angle of + 4° 10′. With rod at B, the intercept observed was 8.12 ft. at a vertical angle of — 10° 10′. The tabular values for V as taken from the table of the previous article for angles of 4° 10′ and 10° 10′ are 7.25 and 17.37, respectively. Assuming an internal focusing instrument, or neglecting the quantity (f + c), the difference in elevation between points A and B is 6.82 ft. × 7.25 + 8.12 ft. × 17.37 = 49.4 + 141.0 = 190.4 ft.

Stadia Traversing

The stadia method is also used to determine the length of lines, hence it is frequently used in traversing. When traverses are run by stadia it is recommended that readings be taken both forward and backward along the line. This procedure not only furnishes a check on the intercept values, but it also supplies a check on the vertical angle. If the average of the vertical angles as read from both ends of the line is used in the calculations, any errors caused by maladjustment of the instrument are eliminated.

Transit-stadia or plane-table-stadia traverses are commonly run to establish points from which the details for a topographic map are taken. The stadia method is particularly adapted to such work because from a single observation the direction of a line can be determined, its length can be calculated and the difference in elevation between the two ends of the line can be found.

Details by Stadia

The speed and economy of the stadia method of surveying are most apparent in the taking of details for the construction of topographic or contour maps. There are several field procedures which may be followed in order to secure the necessary data but the most common is the one known as the controlling-point method. A controlling point is a point on the surface of the earth which controls the general shape of the earth's surface, or contours, on all sides of it. Such points naturally fall at ridge lines and valley lines. They also occur at other points of abrupt change in grade. The transit, or plane table and alidade, are used to sight such controlling points. The instrument is set up over a control point, such as one of the traverse points mentioned above. The transit or plane-table board is oriented by sighting toward another traverse point on either side of the point occupied. The stadia board is in turn held on the controlling points surrounding the point occupied. The readings taken at each place the stadia board is held are intercept, verticle angle, and direction. Fig. 1 is typical of all such sights. From these observations the location of the various points that control the surface of the earth are known. Hence when plotted on a map of chosen scale it is possible to draw contour lines, or lines that connect points of equal elevation, and thus represent the ground relief. By far the largest per cent of contour and topographic maps are drawn from data taken by the controlling point method.

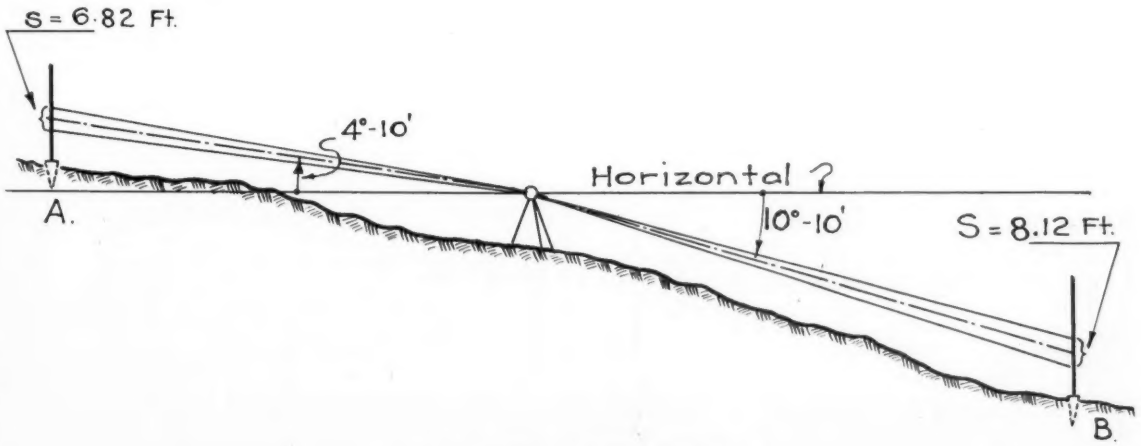

Fig. 1—Trigonometric levels by stadia

Series prepared by Dr. E. A. Stephenson, head of petroleum engineering school, and Prof. D. Don Haines, department of civil engineering, University of Kansas

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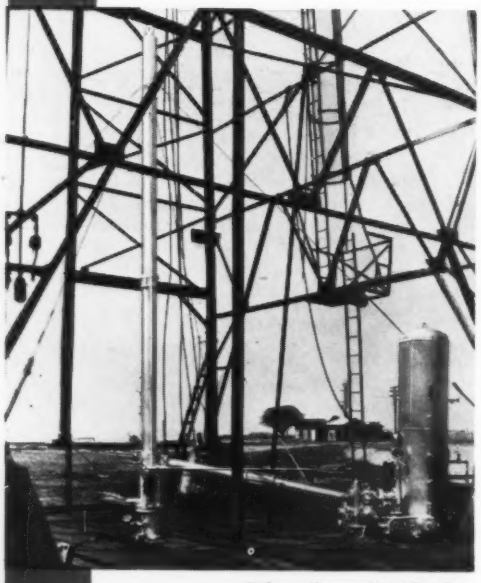

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The Refiner's Notebook

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Shell-Still Heaters

TENTATIVE SCHEDULE OF TOPICS

Topics now being considered in The Refiner's Notebook are:

July 13, No. 101—Open-Type Coolers and Boxes
July 20, No. 102—An Exchanger Design
July 27, No. 103—Shell - Still Heaters
Aug. 3, No. 104—Arrangement of Pipe Stills
Aug. 10, No. 105—Heat of Combustion
Aug. 17, No. 106—Heat Duty of Stills
Aug. 24, No. 107—Heat in Combustion Gases
Aug. 31, No. 108—Viscosity by Different Instruments

ALTHOUGH shell stills are no longer employed in processing the bulk of petroleum they still fill certain needs. Every small refiner needs at least one shell still for the production of naphthas, solvents, specialty products, accumulation of off-specification materials, etc. For such a purpose a unit consisting primarily of an exchanger, preheat tubes, a tower with many plates, and a shell still somewhat as shown in Fig. 1 is a flexible and useful all-purpose installation.

Tables 1 and 2 show the general dimensions and capacity of shell stills when operating on crude oil and producing about 40 per cent of distilled products. Capacities are not much different for narrow-boiling-range stocks because more heat is required for the heat of vaporization. Obviously, capacities are a little greater for low-boiling stocks and particularly so if little material is vaporized.

The distribution of radiation within the fire box of regular shell-still settings is so poor that the rate of absorption per square foot of exposed shell bottom must be kept below about 8,000 B.t.u. per square foot per hour. Absorption rates may be as low as 4,000 for high-boiling stocks or at the end of a batch distillation of crude oil; even lower rates are required for high-boiling stocks that must not be discolored by overheating. Although forced circulation and the use of flues through which the flue gases flow to the stack have been used, a more direct means of increasing capacity is to use wall tubes or a coil on the floor of the shell still. Such tubes should be placed directly under or beside the flame. Flow must always be maintained through such tubes. They make for more uniform radiant heat distribution so that the shell can absorb more heat as well as the good rate of absorption in the tubes themselves. Average rates of 20,000 B.t.u. per sq. ft. have been obtained in this manner when removing naphtha from solutions.

TABLE 1—DIMENSIONS OF COMMON SIZES OF SHELL STILLS

Diameter ft.	Length ft.	Heating Surfaces, sq. ft. Batch Setting	Heating Surfaces, sq. ft. Continuous Setting	Approximate Weight, lb.	Vapor Line Diameter in.
8	24	183	274	17,000	8
10	30	294	440	25,000	10
12	36	428	643	42,000	12
14	42	588	880	56,000	14
15	45	675	1010	66,000	15

TABLE 2—CAPACITIES OF SHELL STILLS

Size Diameter × Length	Internal Volume, bbl.	Charging Capacity, bbl.	Crude Oil Total Batch Charge, bbl.*	Crude Oil Continuous Charge, bbl.
8 x 24	215	180	200 - 250	300 - 400
10 x 30	420	350	400 - 500	600 - 800
12 x 36	725	615	700 - 850	1100 - 1300
14 x 42	1150	1000	1100 - 1300	1600 - 2000
15 x 45	1420	1200	1400 - 1800	2100 - 2700

*Exclusive of charging time.

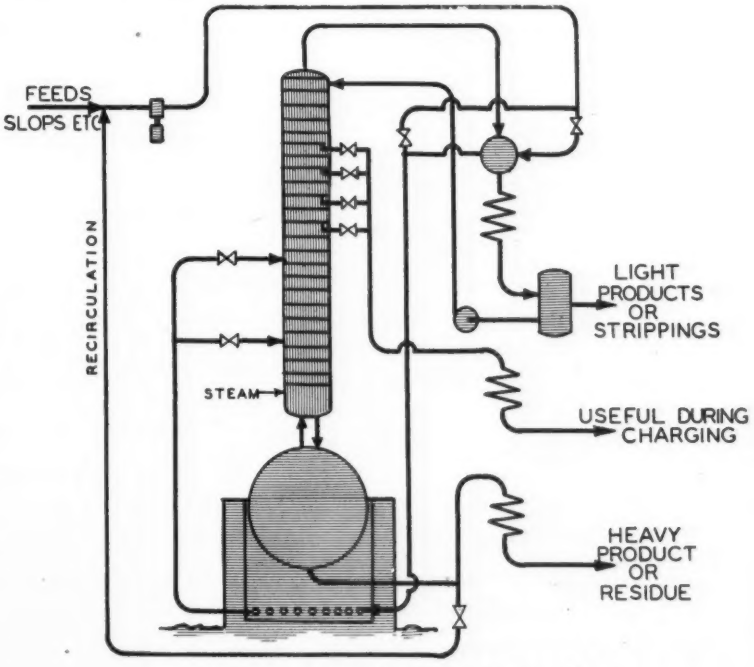

Fig. 1—All-purpose shell-still installation for rerunning, etc.

No. 103 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa

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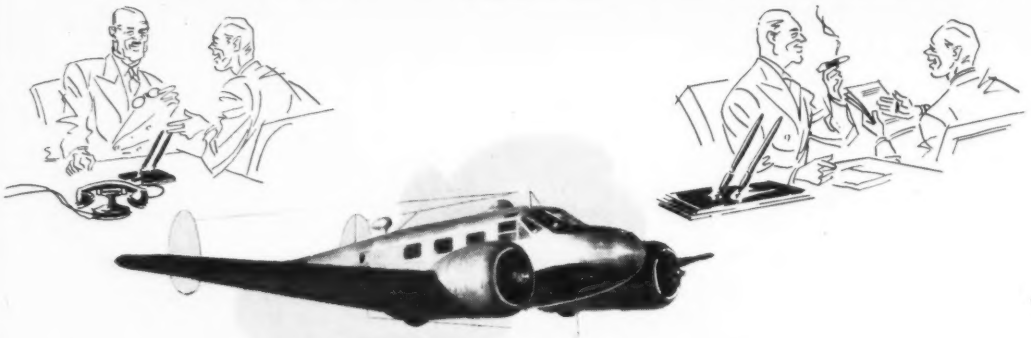

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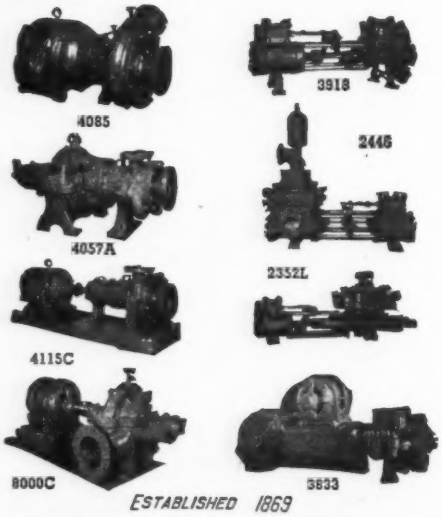

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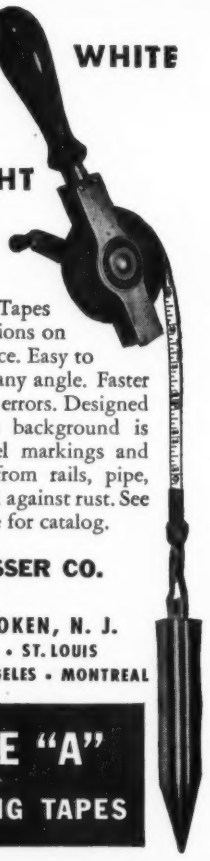

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Pipe-Line Construction

(Continued from page 159)

by three companies. Southern California Gas Co. and the Southern Counties Gas Co. will construct 214 miles of the 30-in. line from near Blythe, Calif., to Santa Fe Springs. The remaining portion from Dumas, Tex., to the point near Blythe, is to be built by El Paso Natural Gas Co.

Among the other major projects is the 405-mile 26-in. line from the Hugoton field to Kansas City planned by Cities Service Gas Co. Colorado Interstate Pipe Line Co. has projected plans for the construction of a 16-in. gas pipe line from the Hugoton field to Denver.

In the products-pipe-line field Phillips Petroleum Co. is considering the construction of a line from its Borger refinery to the Denver area. Another project planned by several refineries in the Casper, Wyo., area would provide a products line from Casper to Denver. Sinclair Refining Co.'s products pipe lines under way now include a line to Detroit from its present Chicago-Toledo line; a line from Toledo via Marion to Columbus, and a third line from Marion to Cleveland, Akron, and Youngstown, which is to connect into present lines at Steubenville, Ohio. Humble Oil & Refining Co.'s products line which is nearing completion connects its Baytown refinery and its Hearne terminal to the Dallas-Fort Worth area. Texas Co. and Magnolia Petroleum Co. have announced plans to build a products line from their Port Arthur and Beaumont refineries to Hearne, and from this terminal to a point between Fort Worth and Dallas. A branch from this line goes to San Antonio via Austin.

Pipe-line construction in the European, Asiatic, and South American areas is also active. The U.S.S.R. is constructing a natural-gas pipe line from the western Ukraine area to Kiev, a distance of about 300 miles. A second gas line is reported to be nearing completion in the U.S.S.R. This pipe line, some 500 miles in length, extends from Saratov to Moscow and present plans include a parallel line between these two cities in the near future. Reports on other U.S.S.R. pipe-line activities show that the building of a 125-mile line from Tuimazy fields to a refinery at Ufa in the Urals was well under way in April of this year.

In the Middle East oil-producing areas Trans-Arabian Pipe Line Co.'s, Standard of California and Texas Co., 1,000-mile pipe line from the Persian Gulf in Saudi Arabia to a Mediterranean port was approved early in 1946.

South American pipe-line activities include several projects. The Bolivian Government Oil Fields 255-mile 6-in. crude-oil pipe line is under way. This carrier extends from Camiri to Tintin. Other pipe-line plans of the Bolivian Government are reported to include 168 miles of 6-in. products line which will run between Camiri and Sucre. Operators in the Lake Maracaibo area of Venezuela have under consideration a big-inch line extending from the fields to the Paraguana Peninsula. For several months a crude-oil line has been discussed which would follow the road now being built jointly by several oil companies from Puerto la Cruz to the vicinity of the Las Mercedes field in the State of Guarico, eastern Venezuela.

Reports from Mexico show that the government there is planning to construct a new pipe line for carrying crude from Poza Rica field to Salamanca in Guanajuato state. Other government plans involving pipe-line construction in Mexico include a 35-million-cubic-foot-per-day transmission system for supplying the industrial needs of Mexico City. Gas Industrial de Monterrey is planning to construct 140 miles of gas line from the international bridge at Hidalgo-Reynosa for serving northern Mexico. Negotiations are under way now with Reynosa Pipe Line Co. to build 30 miles of line from near Weslaco, Tex., to the international bridge.

Reported figures for the first half of 1946 indicate that several thousand miles of pipe line for transporting crude oil have been planned by a large number of companies. The breakdown given in Table 3 is made up from data reported during the first 6 months of this year.

TABLE 3—MAJOR NEW AND EXPANDED CRUDE-OIL PIPE-LINE FACILITIES FOR FIRST HALF OF 1946

Company—	Approx. miles	Size (in.)	Status	Location
Atlantic P. L. Co.	46	8	Planned	Texas
Hamilton P. L. Co.	24	8	Complete	Wyoming
Humble P. L. Co.	276	8	Near comp.	Texas
Interstate Oil P. L. Co.	35	10	Under way	Mississippi
Interstate Oil P. L. Co.	24	8-6	Completed	Illinois
Magnolia P. L. Co.	180	10	Under way	Texas
Magnolia P. L. Co.	35	10	Under way	Texas
Pasotex P. L. Co.	108	8	Planned	Texas
Socony-Vacuum	32	8	Under way	Kansas
Sohio Southern P. L. Co.	40	8	Under way	Mississippi
Stanolind P. L. Co.	200	Various	Under way	Missouri-Illinois
Stanolind P. L. Co.	69	8	.....	Texas
Sun P. L. Co.	130	8-10	Complete	Texas
Talco Asp. & Refg. Co.	11	Various	Under way	Texas
Texas P. L. Co.	285	6-8-10	Under way	Texas
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(Continued from page 165)

process to make 6,000 bbl. per day of liquid product is scheduled for near Brownsville, Tex. Another unit of about the same size is considered seriously for the Hugoton gas field by the group of interests which includes Stanolind Oil & Gas Co. While little has been reported definitely regarding recent catalyst developments, it appears unofficially that the "sintered iron" type catalyst has found most favor; the Fluid principle of catalyst handling is favored, at least by the Hydrocol group. Low-cost oxygen of 60 per cent concentration or higher appears to be very important in preparing the reaction gas mixture in optimum concentrations. Having demonstrated its technical feasibility this process in America has yet to prove its economic practicability. A crude price ceiling of $2 per barrel has been mentioned as the minimum which would make it economic to make gasoline, etc., synthetically by the Fischer-Tropsch reaction. However, the dozen and more oil and development companies which are involved in these various research projects indicate by their number the tremendous interest in and importance of this synthesis which has been referred to by a world-prominent scientist as "the most versatile reaction in organic chemistry."

Many and Varied Products

The days of natural mineral-oil lubricants, refined physically and/or chemically without changing composition or constituents except to remove undesirable materials, appear to have passed definitely for the majority of purposes. Additives for reduction of hydrocarbons in presence of atmospheric oxygen, for improving load-carrying capacity under severe operating conditions, for preventing sludge formation and deposition have not been improved importantly in most cases but have improved in that their application has expanded tremendously. We now have three major classifications of crankcase lubricating oils: regular, which is straight, well-refined mineral oil without addition of nonpetroleum materials; premium, which includes the above plus an antioxidant; heavy duty, which includes mineral oil, antioxidant, and detergent, which latter has the property of suspending sludgy materials in the oil and preventing its deposition within the engine. Development of these additive products has gone on apace, both for aviation and for automotive and other engine applications, with marked success es-

pecially in the more severe duty uses.

Synthetic lubricants have been made from raw materials which are claimed to be nonpetrolic in origin, such as the LB oils announced recently by Carbide & Carbon Chemicals Corp. While exact information of their synthesis has not been disclosed, it is probable that it is carried out via the olefin (possibly ethylene) polymerization route to form highly complex polymers of high viscosity and high viscosity index. It is also possible that complex copolymers are involved. Suffice to say that these products show viscosity indices so high that one viscosity range includes three S.A.E. viscosity grades, with v.i. of 135 and higher. Other synthetic lubricating oils have been formed recently and reported this year, by condensation of olefins such as ethylene with aromatics such as benzene and homologues, using aluminum chloride or boron trifluoride as catalysts, which produces low v.i. oils of good oxidation resistance. The viscosity index of these oils is improved by the addition of voltolized fatty oils, that is, oils which have been treated with silent electric discharges to improve their lubricating properties. These are specialty oils and have attained little importance otherwise in this country.

Micro-Wax, Crude Desalting, Chemicals

Microcrystalline waxes and their uses are forging to the front, coincidental with improvement of methods for recovery of this versatile material. Reports indicate that the water emulsion deoiling methods for waxes are superseding the older sweating methods, with consequent improvement in yields and quality. This new process gives wax of more uniform melting point composition. Chilling wax out of rich oil-lean solvent solutions is said to yield harder waxes than can be obtained by other methods.

A new method for desalting crudes, presumably either in the field or the refinery, involves the use of added water, temperatures of around 200° F. and percolation through one or more layers of Fiberglas has shown excellent results in large-scale experimental work. At least one refinery is building a large installation for this process which is said to cost only 2 mills per barrel of desalted oil to operate.

Petrochemical activities are increasing by leaps and bounds. Several fertilizer (ammonia) units are operating on natural gas, including that leased by Lion Oil Co. from the Ordnance Department; the Monsanto unit at Lake Charles, La., and a third at Pittsburg, Kans. A dozen or more chemical departments are organized by various oil companies and that phase of utilization of petroleum and natural gas is becoming more important each month.

This condensed review of major advances in technology cannot include the tremendous amount of "know how" in operating techniques and in equipment improvement. Such items as baffling bends and curves of catalyst conduits so that the moving catalyst impinges on a static layer of catalyst particles instead of against steel plate or refractory material are typical of these developments.

BOOKS

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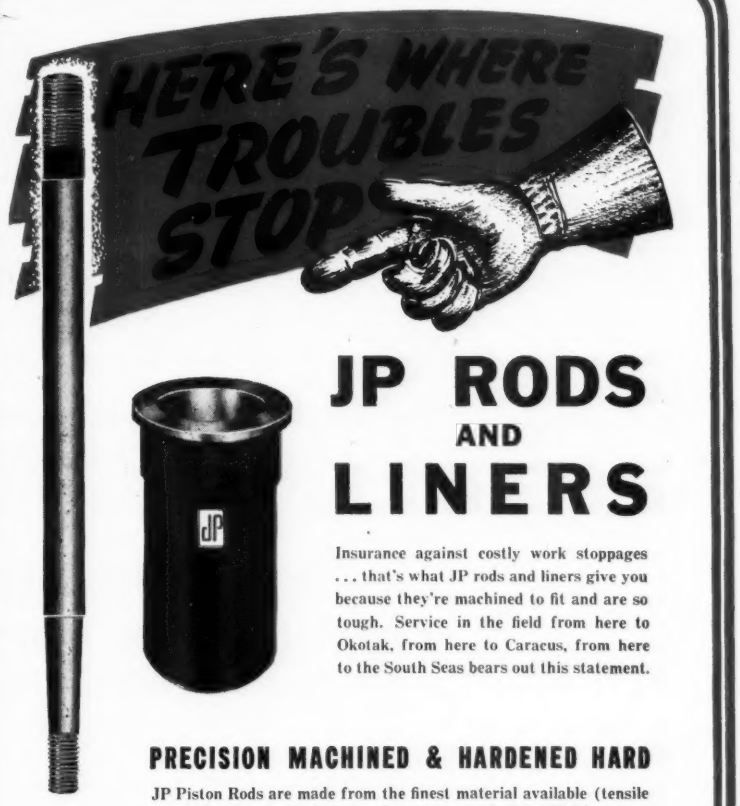
This new volume, and second edition, in the first chapter discusses principles of orifice-meter measurement. Succeeding chapters are on the orifice plate and differential connections, design details of Brown flow meters, flow approximation tables, derivations of working formulas, working equations, compressibility of gases, relationship between coefficient of discharge, viscosity of fluids and orifice calculations for steam, water, oil, and gas flow.



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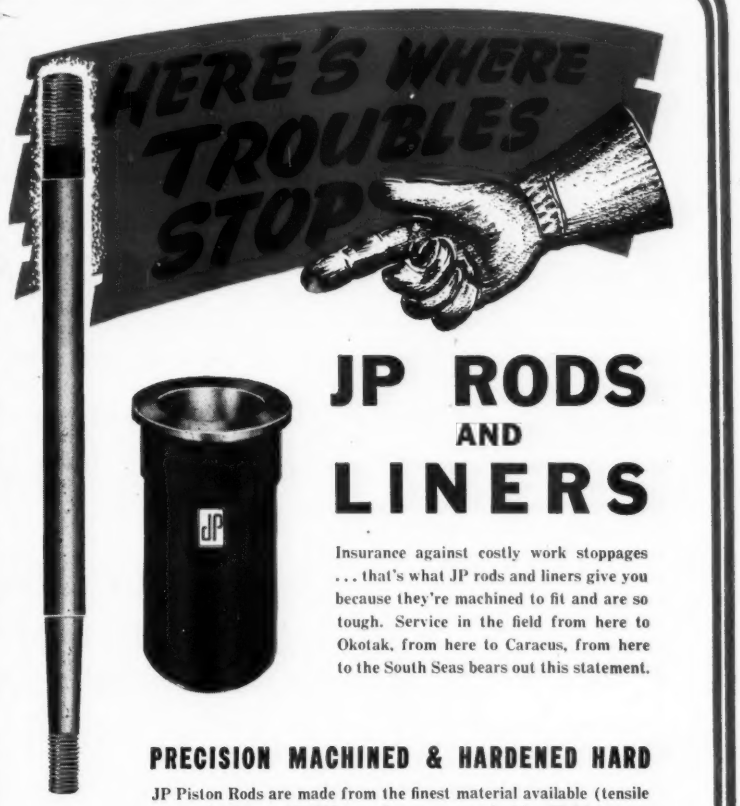

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(Continued from page 157)

reconditioned. Plastics recently have been used in many wells in East Texas for this purpose, and a squeeze method has been developed to set blank liners with them, as well as slotted liners (Journal, May 18 and June 8, 1946).

New records recently have been set both for completing the deepest producing well and the highest-pressure well. Deepest producing well in the world now is the 2 Smith-State Unit 1 in the Weeks Island field, New Iberia Parish, Louisiana. It was completed by Shell Oil Co., Inc., at an approximate cost of $400,000 after being drilled to a total depth of 14,301 ft. and completed at a plugged-back depth of 13,828 ft. Tests indicated it would flow approximately 530 bbl. per day of 33° A.P.I. gravity oil from a formation between the depths of 13,763 ft. and 13,778 ft. through an 11/64-in. choke. (Journal, May 4, 1946).

Highest-pressure well is that of Glenn H. McCarthy in the Blue Lake field, Brazoria County, Texas. Surface pressure was 8,225 psi. An interesting angle to this record-pressure producer is that when the weight of the 11,000-ft. gas column is added to the surface recording, the bottom-hole pressure probably is fairly close to 10,500 psi. (Journal, May 4, 1946).

And what is believed to be now the world's largest gas well is Skelly Oil Co.'s 1-D Werner in the eastern edge of the Carthage gas-distillate field. It has been tested for a reported 480,000,000 cu. ft. daily. The test was made on a Bureau of Mines basis, and bottom-hole pressure was reported steadily increasing when it was ended. (Journal, Mar. 30, 1946).

Many other completion aids and accessory items: alloy casing windows, wall-cleaning guides, and casing centralizers, pack-off casing shoes and similar improved cementing practices are now being used to a greater extent. In an Illinois-Indiana-Kentucky completion program for 64-multiple-sand cementing and completion jobs, to illustrate the progress, a success frequency of 97 per cent was reported (Journal, July 13, 1946). Deeper completions, incidentally, have emphasized the need for improved casing-landing practices, so calculations and charts for determining depth to freeze points of casing strings, temperature changes versus landing head loads, pull-out, buoyance and other factors have been examined (Journal, May 18, 1946).

Production

Whether in lifting operations, reservoir control, pressure maintenance, repressuring, water-flooding work, or on the equipment side, petroleum production engineers and producing people have been doing a lot of things better and handling many new developments. Take natural gas. A recent survey (Journal, May 4, 1946) shows, in the Gulf Coast, processing plants are to be constructed to handle 60 million cubic feet of gas now being vented in 11 fields; that field pressure-maintenance projects are in the discussion stage for Conroe, Thompson, and South Thompson fields; a new absorption plant is under way for the West Beaumont field, plans in the Fairbanks field for injecting 10 million cubic feet of vented gas back into the reservoir; compressors to be installed in the Seabreeze field to deliver to a gas-transmission line 2 million cubic feet of gas now being vented; and that underground storage of gas at the North Withers field is being studied. In South Texas, a pressure-maintenance plant will be put in the Weil field, Jim Hogg County; Barnsdall Oil Co. plans a gasoline plant to handle gas from the Placedo and McFadden fields; and so down the line with projects of Magnolia Petroleum Co., Humble Oil & Refining Co., Plymouth Oil Co., Southern Minerals Corp., and many other operators and fields. The same tempo is found in these activities in

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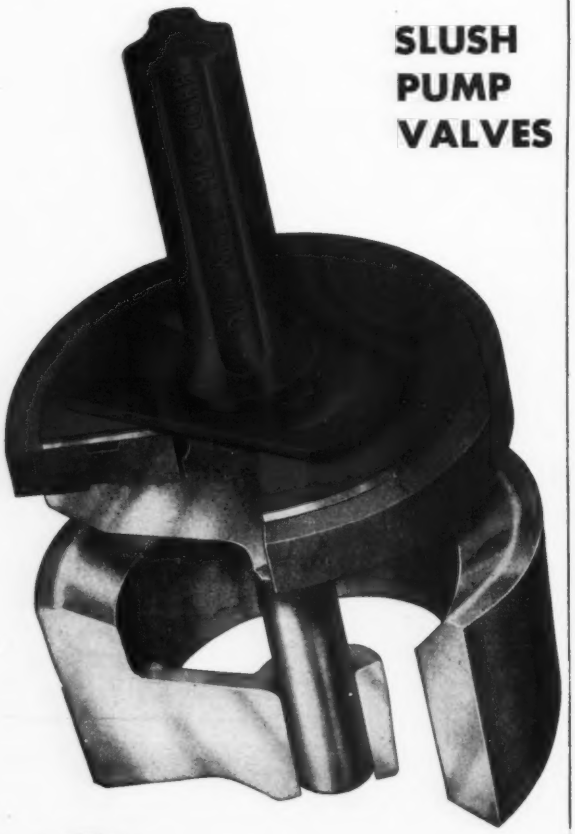

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West Texas, in North and East Texas, and in Arkansas. More than a dozen new "gas" projects of one kind or another are developing in Louisiana. New listings for gas-conservation projects are present in Mississippi, Michigan, and Kansas. The Rocky Mountain area has a half dozen or more new projects, and California is operating several and scheduling more.

On cycling, new projects continue. A good illustration is the Shell's recently installed Sheridan, Tex., cycling plant which produces 300,000 gal. of products daily (Journal, June 1, 1946). In Texas, incidentally, cycling operations have increased 15-fold during the past 7 years.

The Paloma, Calif., recycling plant, to take a still different aspect, approaches in complexity the ramifications of a modern, multiproduct refinery, coupled with the coincident production of extremely high-pressure distillate wells (Journal, Aug. 18 and 25, and Sept. 8, 1945).

Both small and large gasoline plants continue to be installed in older fields as well as in newly discovered pools. Examples of two recently constructed plants where latest advances in engineering design were employed are the large Absorption Plant, Inc., gasoline plant which serves three fields, Fig Ridge, Stowell, and Fannett, 60 miles east of Houston. This plant handles 30 million cubic feet of low-pressure and 55 million cubic feet of high-pressure gas per day. Total products are 85,000 gal. per day; ten 800-hp. compressors are used; there are about 75 miles of gathering line varying from 2 to 30 in. in diameter (Journal, May 25, 1946). The other illustrative plant is that of United Gas Pipe Line Co. in the Carthage field, which manufactures 170,000 gal. of liquid products per day. (Journal, July 20, 1946).

In core analyses, a new method has been developed for recovering the porosity of drill cuttings, which compares favorably with the results obtained from core samples (Journal, Apr. 6, 1946). On corrosion, both the theoretical and field sides have been examined and sodium chromate found effective in dealing with gas wells (Journal, May 4 and 18, 1946). In stopping corrosion induced by hydrogen sulfide gas and by sour crudes, however, formaldehyde has shown promising indications (Journal, Oct. 27, 1945). A new internal-type tubing caliper has been developed which measures the extent and location of corrosion (Journal, April 20, 1946).

Electrification of producing wells goes along in certain pools where physical and economic circumstances are favorable, and in the Smackover pool in Arkansas a big electrification program on individual pumping units was responsible for the lowering of lifting costs 36 per cent.

In reservoir mechanics, a new model oil-pool analyzer has been finished by Carter Oil Co. that can quickly and virtually automatically compute diversified and complex reservoir calculations (Journal, May 18, 1946). Factors in well spacing and ultimate recovery have been discussed by several engineers, both from the theoretical and the case-history side, and the subject of well interference has been similarly treated. Present activities and potentialities of pool engineering committees have been discussed and the values emphasized (Journal, Mar. 23, 1946). The Elk Basin pool of Wyoming is likely the latest successfully executed unitization program, although a score of others are in the formative stage.

The preceding illustrations cover but a few of the activities recently under way or scheduled by the petroleum engineers for early commencement. However, the slide rules, cost figures, equipment catalogs, engineering-data books, and all the other helpful sources are out on the desks. Plans are under way for continuing modern installations and operations all along the line, whether consisting of but an installation of a new tank battery, more pumping equipment, or the unitization and pressure-maintenance operation of a multimillion-barrel reservoir.

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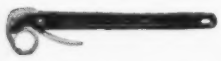

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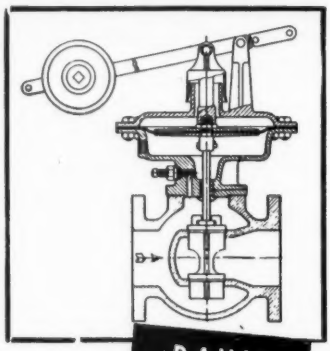

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PIPE LINES

Indiana Standard Planning New Products Pipe Line

CHICAGO.—A pipe line to carry finished petroleum products to Minneapolis and to Moorhead, Minn., across the Red River from Fargo, N. D., is being designed by the Standard Oil Co. (Ind.). Authority to construct certain buildings connected with the line was granted last week by the Chicago office of the Civilian Production Administration.

The line will be 662 miles long and will carry petroleum products from the company's refinery at Whiting, Ind. In addition to Minneapolis and Moorhead, other terminals will be established at intermediate points not yet chosen.

For the greater part of its distance, the pipe will be 10 in. The rest of the line will be 8 in. Pumping stations will be built at intervals along the line.

Construction will begin within the next few weeks. The line is expected to be ready for use in delivery of petroleum products early in 1947.

Pipe-Line Flow Shows Increase During April

WASHINGTON.—Pipe-line carriers transported 3.2 per cent more crude oil to refineries in intrastate movements, and 2.2 per cent more in interstate movements during April than they did in March, according to the Bureau of Mines' monthly crude petroleum report.

While net movements were slightly higher in March due to the additional day, daily averages in April were increased. April intrastate movements averaged 2,449,000 bbl. daily and interstate shipments averaged 1,070,000 bbl. daily, compared with 2,373,000 bbl., and 1,047,000 bbl. daily, respectively, for the previous month.

Total receipts at refineries by pipe lines during April included 73,471,000 bbl. by intrastate pipe lines and 32,092,000 bbl. by interstate lines. March receipts were 73,577,000 bbl. by intrastate pipe lines and 32,446,000 bbl. by interstate lines.

FPC Approves $5,327,500 Hope Natural Program

WASHINGTON. — Hope Natural Gas Co., Clarksburg, W. Va., has been authorized by the Federal Power Commission to construct and operate major additions to its present transmission system in West Virginia.

The facilities, estimated to cost $5,327,500, are planned to augment Hope's transmission pipe-line system in order to provide adequate supplies of natural gas to meet existing and increasing demands and to insure maintenance of adequate service to East Ohio Gas Co., an affiliate, and other customers during the winter season of 1946-47. They include installation of a total of 3,000-hp. compressor capacity in the Hastings and Jones compressor stations, construction of about 64 miles of 12¾-in. loop line to parallel existing lines, about 24 miles of 20-in. loop line also paralleling existing lines, approximately 55 miles of 12¾-in. line to extend from the Jackson compressor station to Baileysville magisterial district in Wyoming County, installation of a new dehydration plant, gas coolers and piping changes to Cornwell com-

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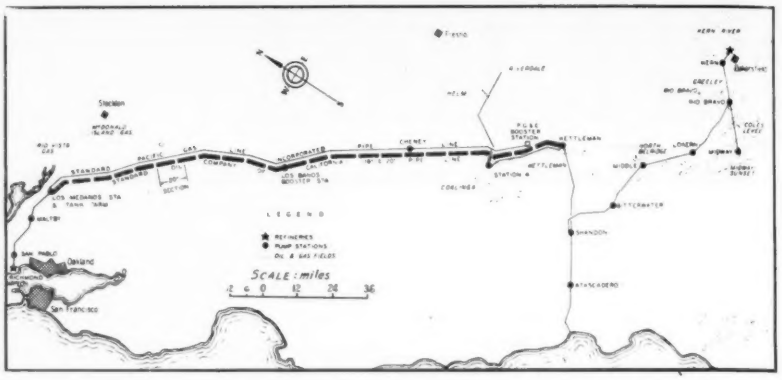

This map shows the route of Standard Oil Co. of California's new 176-mile crude line extending through San Joaquin Valley to San Francisco Bay. The 18-in. and 20-in. line was recently placed in operation. It cost $4,000,000 and has a capacity of 110,000 bbl. daily. It is the largest-diameter crude oil line in California. Complete details on the project were carried in The Oil and Gas Journal, issue of July 20, page 80

pressor station and construction of additions to the present dehydration plant at Jackson compressor station.

Research Engineers Describe New Leak Test Equipment

DETROIT. — A specially designed mass spectrometer that reveals gas leakages so minute that they defied conventional detection methods was described in detail by two research engineers at the recent American Institute of Electrical Engineers convention here. According to the authors, W. G. Worcester and E. G. Doughty, both of the General Electric general engineering and consulting laboratory, the specially developed leak detector can disclose the presence of one part of helium in 200,000 parts of air.

East Ohio Gas Authorized To Lay 144-Mile Pipe Line

WASHINGTON.—East Ohio Gas Co., Cleveland, has been authorized to construct and operate a 144-mile pipe line extending from Hope Natural Gas Co.'s outlet at the Ohio-West Virginia state line to the outskirts of Cleveland, according to the Federal Power Commission. Cost is estimated at $4,620,000.

East Ohio's proposed line is for the purpose of receiving increased natural gas supplies from Hope to meet consumers' requirements which the company estimates reached a daily maximum of about 435,000,000 cu. ft. during the last winter. The company's gas system at present has a delivery capacity of about 355,000,000 cu. ft. daily.

The facilities authorized to enable the company to alleviate this shortage consist of 95 miles of 18-in. line extending from Pipe Creek on the Ohio River, the location of Hope's terminal, to the vicinity of Austintown Junction, Mahoning County, Ohio, where a portion of the gas will be used to supply the Youngstown and Warren division, and about 49 miles of 20-in. line to Dunham station in Maple Heights, a suburb of Cleveland. The line will have an initial capacity of 119,000,000 cu. ft. of gas daily.

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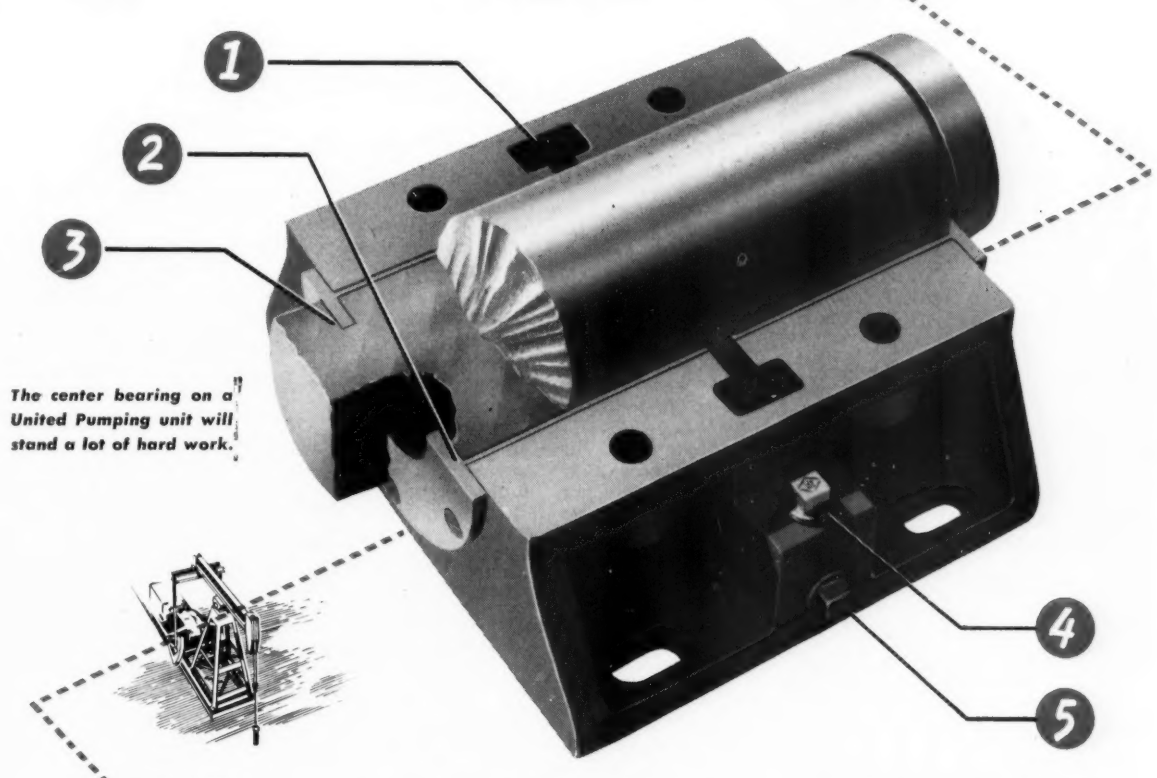

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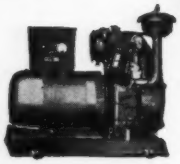

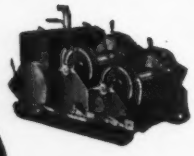

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REFINING

Vaporizing-Burner Fuel Specifications Adopted

CHICAGO.—New fuel-oil specifications for vaporizing pot-type oil burners were announced last week by the oil division of the Institute of Cooking and Heating Appliance Manufacturers.

Specifications adopted include: A.P.I. gravity, 36 minimum at 60° F.; viscosity, kinematic at 77° F., 2.3 minimum and 2.9 maximum; distillation range, 10 per cent at 420° F. maximum, and flash point at 625° F. maximum.

In approving a 2.3 minimum and 2.9 maximum kinematic viscosity at 77° F., the institute differed from proposed specifications of the American Society for Testing Materials, which call for a 2.4 maximum at 100° F., and no minimum. Burner manufacturers then agreed on the minimum-maximum figure.

The oil division of the institute said the fuel-oil requirements for vaporizing oil burners is the largest in the domestic heating field and present consumption is estimated at 38,690,000 bbl. annually, with burner manufacturers gearing for mass production which will boost consumption considerably.

Court Directs Return of Jersey Standard Patents

NEW YORK.—Approximately 70 per cent of the 798 Standard Oil Co. (N. J.) patents which were seized on May 24, 1944, by the Alien Property Custodian, because of alleged German interests, has been returned. Alien Property Custodian James E. Markham was directed to return these patents by Boston's Federal Judge Charles E. Wyzanski, Jr., July 8.

Jersey attorneys estimate that the company retains "title or at least exclusive licensing rights" to 70 per cent of the 798 patents or patent applications that the plaintiffs sought to recover.

Concerning important buna-rubber patents, alien property custodian attorneys said that these patents had been granted royalty free to all manufacturers by Jersey "to expedite the synthetic rubber program."

The custodian is also directed to return to Jersey 200 shares of the capital stock of the Standard Catalytic Co. and to return to the Standard Oil Development Co. 250 shares of the capital stock of the Hydrocarbon Synthesis Corp. It also ordered either the delivery to Standard Development of five shares of Jasco, Inc., or the payment of $4,000.

Within 40 days from the July 8 date, the decree provisions are to be fulfilled, but jurisdiction of other questions that may be disputed is retained by Judge Wyzanski.

This suit originated when the Government physically seized patents and securities formerly owned by the German chemical trust, I. G. Farbenindustrie. Patents involved processes for refining and treating crude oil, the manufacture of gasoline and lube oil from solids and gaseous hydrocarbons, and the manufacture of 100-octane gasoline and toluol. The patents were part of a $35,000,000 purchase from I. G. Farben in 1929 and 1939.

German Wax Production Described in Report

WASHINGTON.—German pilot-plant production of a new wax which had been found useful as a casting material for the cable industry in Germany is described in a report on high-pressure polymerization of ethylene, now available from the Office of Technical Services, Department of Commerce. Another report describes I. G. Farben's experiments with emulsion polymerization of ethylene. The new wax product, known as "I. G. Wax A Lupolen N," has a low molecular weight and melts at 105-110° C. It was made in a pilot plant at Zweckel, Germany, by polymerizing ethylene at 200 atmospheres pressure.

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Special Uses Seen for Synthetic Lubricants

SAN FRANCISCO. — In a general discussion of the advances made in the refining industry, F. S. Clulow, vice president in charge of manufacturing of Shell Oil Co., Inc., predicted that synthetic lubricants, though not likely to replace present oils, will undoubtedly be used for special purposes.

Clulow said developments in synthetic lubricants "opens up another new field." It has been found, he added, that lubricants can be made synthetically that are quite different from the lubricants found in petroleum.

In an article in the current issue of Shell News, the manufacturing executive said the problem of lubrication is becoming more and more severe with the ever-increasing power output of engines. "Good lubricating oils of today will have to be further improved to meet the exacting conditions of tomorrow," he said. "The difficulties that confront us are many: ring sticking, bearing corrosion, lacquering pistols, sludge formation, wear and in some extreme cases, even how to lubricate the mechanism at all.

"There are two methods of tackling this problem. One is to improve the lubricating oil itself by better refining methods, and the other is to add other compounds to the oil to achieve the desired result. Much has already been done in both directions, but more must be done in the future."

As an example of the wide scope of refining operations, Clulow said future developments can have a great bearing on the nation's food supply. "For years," he continued, "we have supplied spray oils in combating crop-destroying pests and these can be further developed. Fertilizers, soil fumigants, weed killers, and growth-promoting substances can be made from petroleum, and some are being produced already."

Clulow has held nearly every job a refinery offers. Following service in World War 1, he entered a Shell laboratory. In 1930, he became chief technologist and later assistant manager at the Martinez, Calif., refinery. After service in Montreal and at East Chicago, Ind., he returned to the Pacific Coast in 1938 as manager of the manufacturing department. Later in the same year he became vice president.

Shell Foremen, Operators Given Special Course

HOUSTON.—To give shift foremen and operators an idea of the theoretical principles underlying their daily work, a 1-week course was recently conducted at the chemical plant of the Houston refinery of Shell Oil Co., Inc.

The work comprised study, lecture, both oral and written quizzes, and practical demonstrations. Members of the refinery staff wrote a special 150-page text for the course, while the operating and technological department furnished 10 instructors. Subjects covered included basic chemistry, principles of temperature and pressure measurement, principles of distillation, instruments and controls, pumps and compressors, and various processes used in the refinery.

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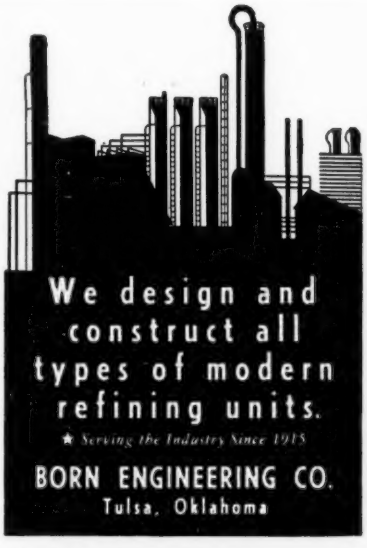
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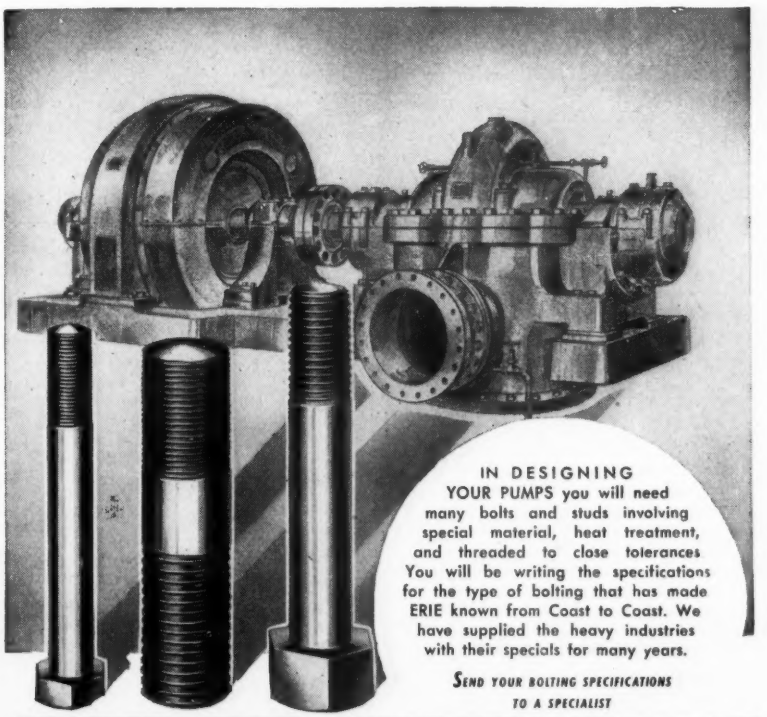
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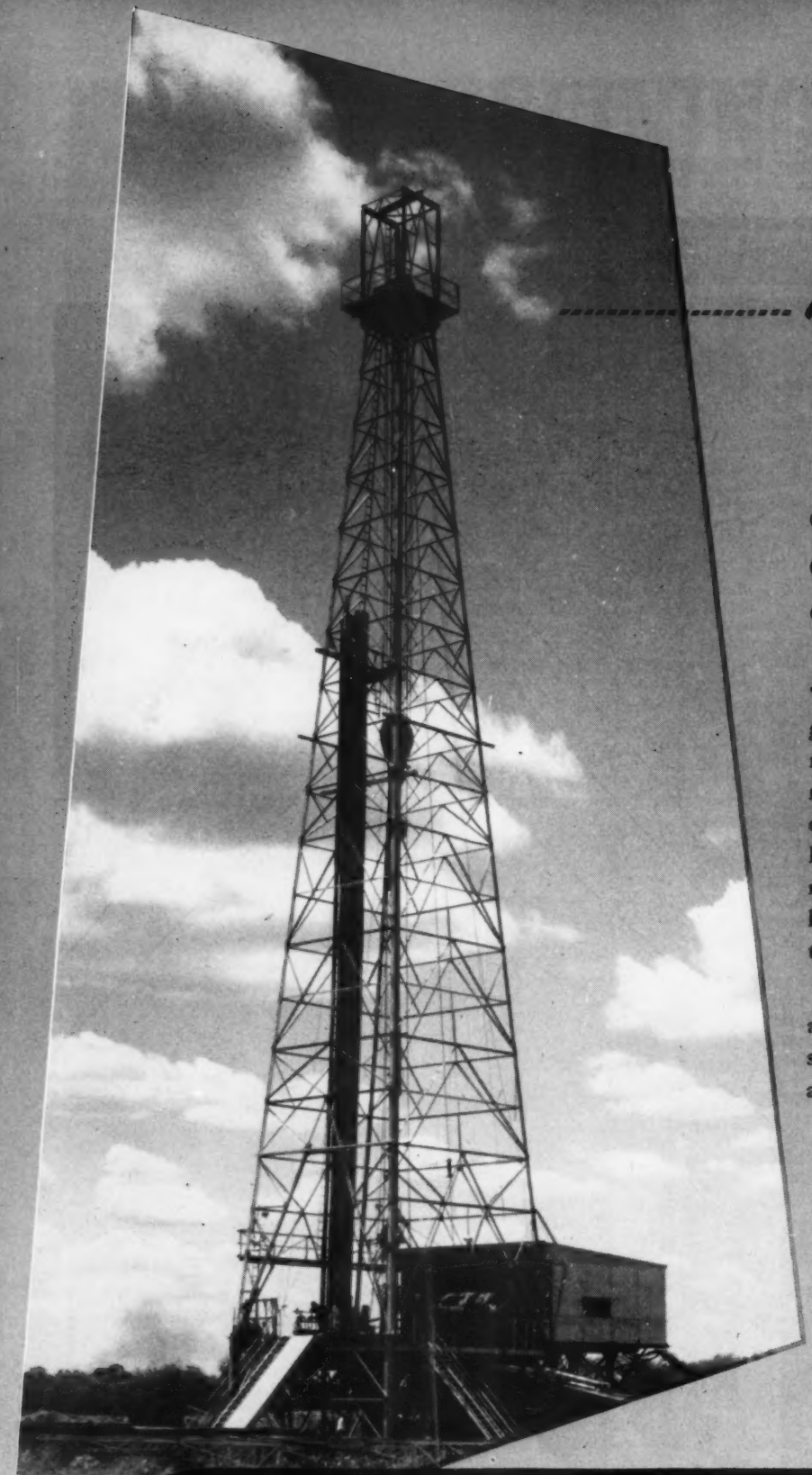

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NATURAL GAS

Wrapping Contract Let For California Gas Line

LOS ANGELES. — Plans for the 214-mile section of the Texas-California natural-gas pipe line between Blythe and Santa Fe Springs, Calif., moved forward last week when a contract for cleaning, coating, and wrapping was let to Bechtel Brothers-McCone Corp., according to B. M. Laulhere, manager of engineering services for Southern California Gas Co. and Southern Counties Gas Co.

Due to the size of the pipe, which will be the largest long-distance transmission line in the nation, it will be necessary to use a central location for coating and wrapping the line. The site chosen for the operation adjoins the Consolidated plant where the pipe will be fabricated. Here the contractor will install facilities necessary for wrapping. The contract involves some 1,100,000 linear feet of pipe.

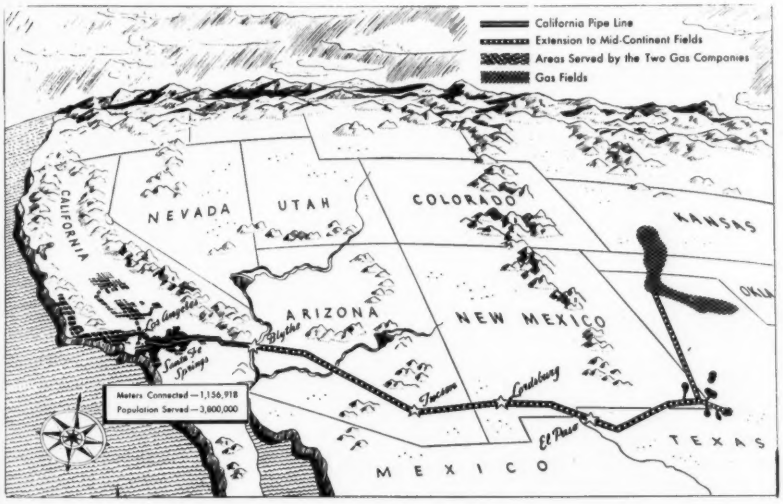
Laulhere said construction of his companies' portion of the line is now scheduled to start the first of next year. Present plans call for bids early in August and contracts will be awarded in September. Five surveying parties are now completing their field work covering the route from Santa Fe Springs to Blythe.

Program Outlined for Gas Technology Short Course

KINGSVILLE, Tex.—Improvements in gas-transmission facilities and industrial utilization will be stressed in a 3-day gas technology short course opening at the Texas College of Arts and Industries here August 27.

Sponsored by the Southern Gas Association, the course is open both to students and members of the natural-gas industry. Instructors will be industry representatives and members of the college faculty. The general plan of the course was outlined recently by Dr. Frank H. Dotterweich, head of the college engineering department and Robert R. Suttle, managing director of the association.

A total of 12 hours will be spent in classroom and laboratory instruction. Trips to gas fields and cycling plants are on the program as well as demonstrations of new-type equipment. The Kingsville Chamber of Commerce is sponsoring a trip to the King Ranch and a barbecue for the course visitors.



This map traces the route to be followed by the $70,000,000 Texas-California natural-gas pipe line. The Federal Power Commission has given its approval to the project, designed to provide a supply to supplement California's own declining gas production. El Paso Natural Gas Co. will build the section extending from fields in the Texas Panhandle to the Arizona-California state line. Southern Counties Gas Co. and Southern California Gas Co. will construct the section in California. The two California companies expect to start work on their section of the 1,200-mile line around October 1, provided pipe and materials are available. The right-of-way for the California section is being surveyed, and this part of the job, including topographic and profile work, is due to be completed in the next few weeks.

May Natural-Gas Sales Decline 5.1 Per Cent

NEW YORK.—May sales of natural gas were off 5.1 per cent from May sales in 1945, according to the American Gas Association. In May of this year, sales were 1,773,506,000 therms compared with 1,868,002,000 therms for May, 1945. The association's natural-gas index for May was 186.6 (1935-39 = 100).

For the 12 months ending May 31, 1946, natural-gas sales to ultimate consumers were estimated to be 21,783,539,000 therms, compared with 22,567,427,000 therms for the same period ending in 1945, a decrease of 3.5 per cent. One therm equals about 100 cu. ft. of natural gas.

Sale of Holding Approved

United Gas Improvement Co., Philadelphia, was recently authorized by the Securities and Exchange Commission to sell its stock holdings in Kansas City Gas Co. and Wyandotte County Gas Co. for an aggregate sum of $5,150,000 to the respective companies.

Natural Gasoline

Daily Natural-Gasoline Output Gains in April

WASHINGTON. — Daily average production of natural gasoline and allied products increased some 70,000 gal. in April over March, according to the Bureau of Mines monthly report.

Daily average for April was 12,702,000 gal., compared with 12,632,000 gal. in March and 12,961,000 gal. in April 1945. The greatest increases were reported in East Texas and Louisiana, with decreases in the Texas Panhandle and Oklahoma. Total April production was 381,049,000 gal., compared with 391,584,000 gal. for the longer month of March.

Total demand of natural gasoline and allied products at plants rose 4.4 per cent, to 386,171,000 gal. in April, compared with 370,016,000 gal. in March and 391,795,000 gal. in April 1945. Total demand at plants for the period of January-April was 1,519,968,000 gal. in 1946 and 1,591,266,000 gal. in 1945.

April 30 natural-gasoline stocks at refineries were 97,146,000 gal., with 196,082,000 gal. at plants and terminals. March 31 stocks were 88,116,000 gal. and 191,540,000 gal., respectively.

STATISTICS and

WEEKLY WELL COMPLETIONS . . . WEEK ENDED JULY 20, 1946

	Total of all wells					Cum. to date		Wildcat completions and discoveries					Cumulative total, 1946				
	Comp.	Oil	Gas	Dry	Footage	1946	1945	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	30	15	0	*15	41,251	866	753	0	0	0	0	0	0	0	0	0	0
Pennsylvania	73	37	5	†31	116,911	2,202	2,154	0	0	0	0	0	0	0	0	0	0
West Virginia	8	1	4	3	21,144	381	445	0	0	0	0	0	0	0	0	0	0
Ohio	32	9	14	9	80,524	652	490	0	0	0	1	1	2	0	10	21	33
Indiana	6	3	0	3	13,972	186	105	0	0	0	1	1	2	0	0	11	13
Kentucky	8	1	3	4	21,243	256	251	0	0	0	0	0	2	0	0	20	22
Illinois	39	16	0	23	100,505	1,187	917	0	0	0	12	12	23	0	0	213	236
Michigan	17	7	4	6	20,862	438	417	0	0	0	5	5	15	0	5	141	161
Kansas	34	22	7	5	104,212	1,074	912	0	0	0	2	2	15	0	0	133	148
Neb., Mo., Iowa	0	0	0	0	0	9	12	0	0	0	0	0	0	0	0	5	5
Oklahoma	78	32	21	‡25	245,926	1,356	1,341	1	0	2	10	13	44	0	25	167	236
Texas	154	85	13	56	771,344	4,394	3,974	2	0	0	31	33	104	18	16	711	849
North Central	45	22	0	23	127,305	1,587	1,184	0	0	0	8	8	28	0	2	293	323
West	39	29	0	10	221,704	919	1,024	0	0	0	8	8	29	0	1	96	126
Panhandle	4	2	1	1	11,955	186	302	0	0	0	0	0	0	0	0	5	5
Eastern	5	2	2	1	21,316	393	185	0	0	0	0	0	10	0	1	49	60
Gulf Coast	38	24	8	6	299,557	977	907	0	0	0	6	6	24	16	7	145	192
Southwest	23	6	2	15	89,507	332	372	2	0	0	9	11	13	2	5	123	143
Louisiana	31	15	3	13	211,464	715	551	0	0	0	4	4	32	5	4	92	133
Northern	15	8	2	5	62,235	390	197	0	0	0	1	1	6	0	0	49	55
Southern	16	7	1	8	149,229	325	354	0	0	0	3	3	26	5	4	43	78
Arkansas	3	1	1	1	11,629	100	99	0	0	0	0	0	4	0	0	20	24
Mississippi	8	0	1	7	47,663	146	195	0	0	0	1	1	1	0	1	40	42
Southeastern States	2	1	0	1	16,197	25	32	1	0	0	1	2	1	0	0	21	22
Montana	8	4	3	1	15,392	159	175	0	0	0	1	1	9	0	0	18	27
Wyoming	5	3	0	2	27,314	93	110	0	0	0	2	2	9	0	3	24	36
Colorado-Utah	4	4	0	0	25,404	74	21	0	0	0	0	0	3	0	0	9	12
New Mexico	6	5	0	1	23,693	197	241	0	0	0	0	0	3	0	0	23	26
California	30	23	1	6	131,734	997	1,294	0	0	1	4	5	5	0	3	119	127
Total United States	576	284	80	212	2,048,384	15,507	14,489	4	0	3	75	82	274	23	67	1,788	2,152
Total previous week	536	277	68	191	1,758,058	14,931	13,946	9	0	4	64	77	270	23	64	1,713	2,070
Total July 21, 1945	533	294	55	184	1,864,327			8	3	5	59	75	291	16	77	1,852	2,236

Service wells included: *15, †29, ‡1.

MARKET QUOTATIONS

(Quotations shown here are f.o.b. plant in tank cars and in cents per gal. as of last Monday.)

REFINERY GASOLINE

Octane (A.S.T.M.)	78-78½†	73-75
Mid-Continent*	6.750	6.000
Texas Gulf Coast	6.375	5.750
New York Harbor	7.700	6.800
California		6.00-6.875

*Basic Oklahoma Group 3. †1939 C.F.R. (research method).

NATURAL GASOLINE

Grades:	26-70	18-55
Oklahoma (Group 3)	3.500	4.200
N. Texas (f.o.b. plant)	3.000	3.600
N. Louisiana (f.o.b. plant)	3.375	4.050
California	4.875	5.500

CRUDE-OIL PRICES

Representative posted schedules per bbl.	
East Texas	$1.35
Conroe	1.53
Tepetate, Louisiana, avg. grav.	1.30
Illinois Basin	1.47
Pecos County, Texas	1.05
Bradford, Pennsylvania	3.10
Van, Van Zandt County, Texas	1.18

Note: Exclusive of subsidy.

GRAVITY SCHEDULES

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Texas	West Tex.*
18-18.9	$1.03	....	....	....
19-19.9	1.03	....	$1.16	$0.80
20-20.9	1.03	$0.95	1.18	.82
21-21.9	1.03	.97	1.20	.84
22-22.9	1.06	.99	1.22	.86
23-23.9	1.10	1.01	1.24	.88
24-24.9	1.13	1.03	1.26	.90
25-25.9	1.17	1.05	1.28	.92
26-26.9	1.21	1.07	1.30	.94
27-27.9	1.25	1.09	1.32	.96
28-28.9	1.28	1.11	1.34	.98
29-29.9	1.30	1.13	1.36	1.00
30-30.9	1.33	1.15	1.38	1.02
31-31.9	....	1.17	1.40	1.04
32-32.9	....	1.19	1.42	1.06
33-33.9	....	1.21	1.44	1.08
34-34.9	....	1.23	1.46	1.10
35-35.9	....	1.25	1.48	1.12
36-36.9	....	1.27	1.50	1.14
37-37.9	....	1.29	1.52	1.16
38-38.9	....	1.31	1.54	1.18
39-39.9	....	1.33	1.56	1.20
40 and above	....	1.35	1.58	1.22

*Includes Lea County, New Mexico.

A.P.I. REFINERY REPORT

Week ended July 13, 1946

(Figures in thousands of barrels)

	Dly. crude runs to stills	Stocks: Gasoline	Distillate	Residual
East Coast	816	22,956	12,864	9,675
Appalachian	137	3,243	575	361
Ill., Ind., Ky.	775	17,417	5,967	4,191
Okla., Kan., Mo.	390	8,157	2,573	1,388
Inland Texas	230	2,879	422	710
Tex. Gulf Cst.	1,198	14,161	6,903	4,415
La. Gulf Cst.	332	3,965	2,078	1,489
N. La., Ark.	59	1,861	488	165
Rocky Mtn.	137	1,908	536	790
California	801	14,206	9,491	25,146
Total 7-13-46	4,875	90,753	41,897	48,330
Total 7-6-46	*4,879	91,712*	39,526	47,743
Total 7-14-45	4,968	85,322	34,740	41,787

*Revised.

CRUDE-OIL STOCKS

(Bureau of Mines Estimate)

Week ended—	Bbl. of crude*
July 13, 1946	222,859,000
July 6, 1946	222,377,000
July 14, 1945	216,355,000

*Excludes unrefinable Calif. stocks.

TRENDS

DAILY AVERAGE PRODUCTION FOR WEEK

	July 20 crude oil	B. of M. July demand	July 13 crude oil
Alabama	1,150	950	1,200
Arkansas	80,500	78,000	79,800
California	887,750	844,000	876,250
Colorado	32,450	28,000	30,110
Eastern	64,000	64,000	64,500
Florida	200	250	200
Illinois	206,900	210,000	208,350
Indiana	18,650	19,000	18,300
Kansas	275,650	260,000	271,750
Kentucky	31,700	31,000	31,150
Louisiana	390,550	380,000	389,850
North Louisiana	89,900	.....	89,200
South Louisiana	300,650	.....	300,650
Michigan	46,500	47,000	50,810
Mississippi	64,000	60,000	67,000
Montana	25,130	22,000	26,490
Nebraska	750	800	750
New Mexico	98,150	97,000	98,150
Oklahoma	383,750	384,000	384,850
Texas	2,227,550	2,110,000	2,227,550
District 1 (Southwest)	19,500	.....	19,500
District 2 (Southwest)	158,100	.....	158,100
District 4 (Southwest)	228,000	.....	228,000
District 3 (Gulf Coast)	511,350	.....	511,350
District 5 (Eastern)	44,150	.....	44,150
District 6 (Eastern)	107,800	.....	107,800
East Texas Field	315,000	.....	315,000
District 7C (West)	28,000	.....	28,000
District 8 (West)	569,150	.....	569,150
District 7B (W. Central)	32,000	.....	32,000
District 9 (N. Central)	129,300	.....	129,300
District 10 (Panhandle)	85,200	.....	85,200
Wyoming	112,460	112,000	109,430
Total United States	*4,947,790	4,748,000	4,933,760
Change from previous week	up 14,030		

Total production January 1-July 20 ..... †945,622,409 bbl.
Same period last year (crude, plus condensate).. 966,593,600 bbl.

*Not incl. 21,500 bbl. condensate. †Incl. 5,059,900 bbl. condensate.

CRUDE-OIL STOCKS 222,859,000 bbl. as of July 13—up 482,000 bbl. One year ago 216,355,000 bbl.

GASOLINE STOCKS 90,753,000 bbl. as of July 13—down 959,000 bbl. One year ago 85,322,000 bbl.

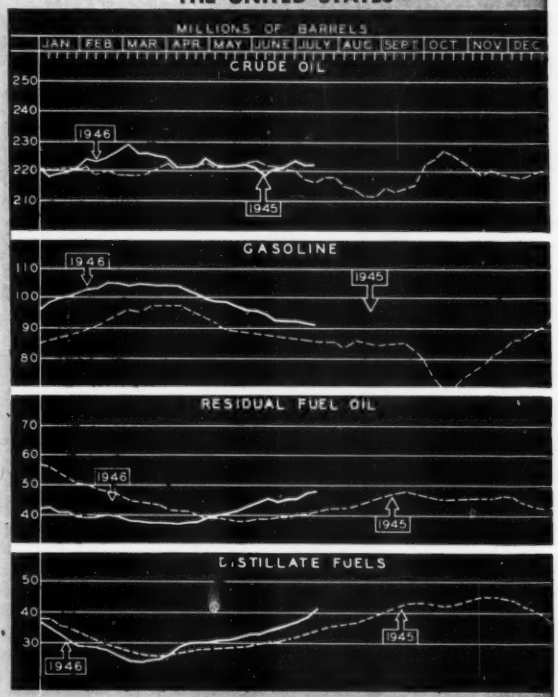
RESIDUAL FUEL-OIL STOCKS 48,330,000 bbl. as of July 13—up 587,000 bbl. One year ago 41,787,000 bbl.

GAS OIL AND DISTILLATE STOCKS 41,897,000 bbl. as of July 13—up 2,371,000 bbl. One year ago 34,740,000 bbl.

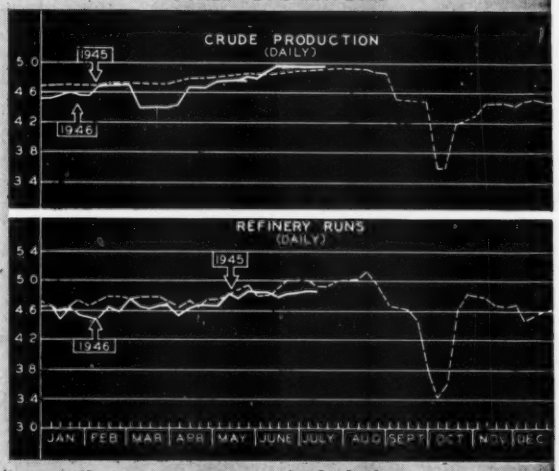
CRUDE-OIL PRODUCTION 4,947,790 bbl. as of July 20—up 14,030 bbl. One year ago 4,939,600 bbl.

REFINERY RUNS 4,875,000 bbl. daily week ended July 13—down 4,000 bbl. One year ago 4,968,000 bbl.

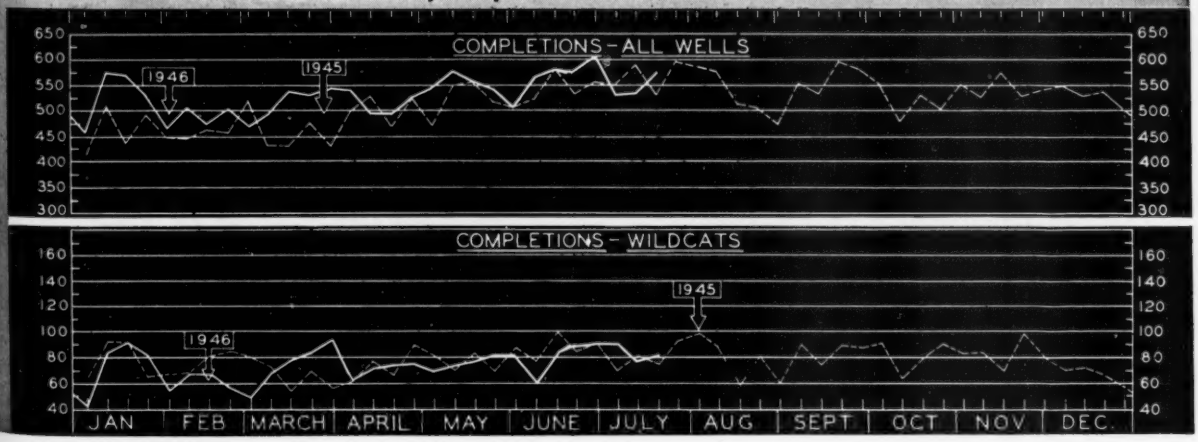
OIL STOCKS IN THE UNITED STATES



DAILY OPERATIONS



Solid line charts weekly completions, service wells in Eastern area included



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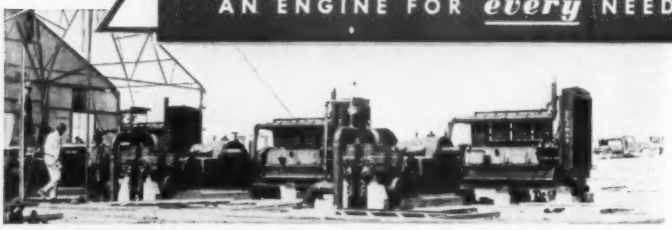
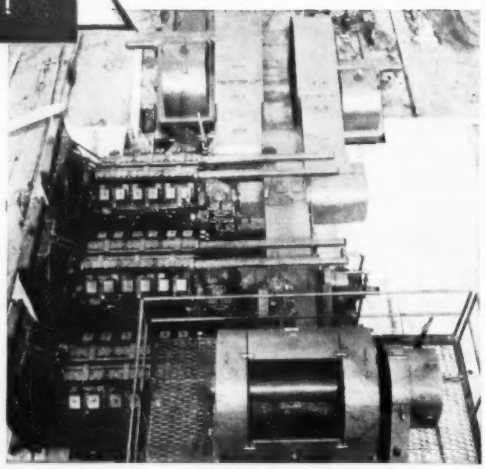
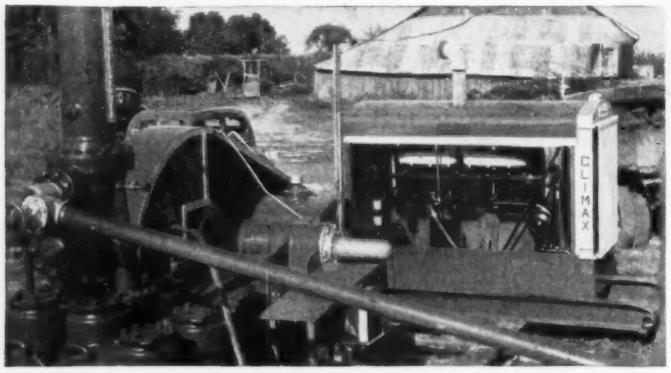


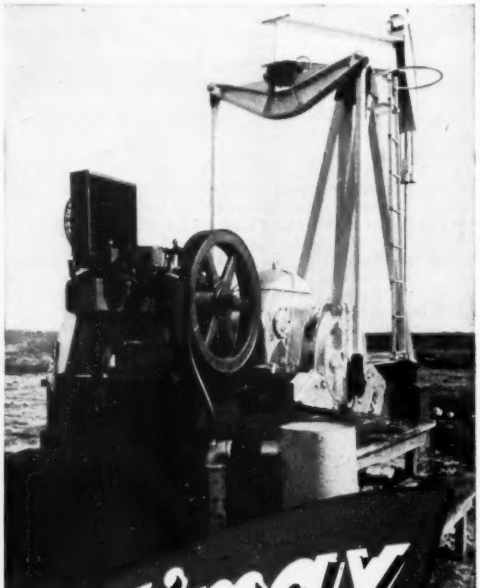
Pipe Line Pumping—R-225 eight-in-line engines deliver reliable power for pipe line pumping. These Climax engines have the stamina required for pumping service. Rated 210 h.p. at 1000 r.p.m. (complete power unit) for pipe line service.



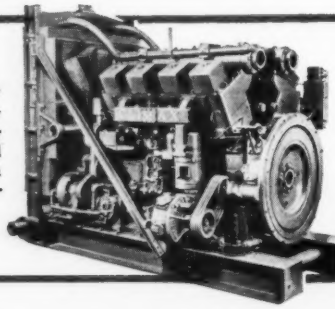
Deep Drilling—VU 420's get the hole down fast and at low cost. Plenty of power to hoist long strings of drill pipe quick—to drive big pumps—to cut your costs per foot drilled. Rated 420 h.p. (complete power unit) at 1100 r.p.m.



Slush Pump. R6I engine driving separate mud pump on drilling rig. A sturdy dependable engine for pumps, small rigs, etc. Rated 150 h.p. at 1050 r.p.m. as completely equipped power unit.



VU 280. 8 cylinders, 60° V-type. A rugged engine for hard, deep drilling and other heavy duty service. Rated 280 h.p. at 1100 r.p.m. with radiator, fan and other accessory equipment.



AT RIGHT: ***Oil Well Pumping*** — Climax CSCO-66 oil well pumping engine. Quick starting—smooth running. Single cylinder simplicity plus modern refinements mean trouble-free operation of this 4-cycle engine with a minimum of attention. Rated 13 h.p. at 650 r.p.m.

■ For illustrated bulletins and complete specifications on these and other Climax Blue Streak Engines, showing the *many* applications for which each engine is suited, write Climax Industries, Inc., Climax Engineering Division, Clinton, Iowa. *Regional Offices: Chicago, Tulsa, New York.*

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Exploration and Drilling

Fullerton Pre-Permian Prospects

THE Pre-Permian prospects of the Fullerton field were substantially enhanced by the results of Fullerton Oil Co. 342-A Willson, approximately SE NE Section 16, PSL A-32. Although this is the second Ellenburger producer in the field proper, it is the numerous good tests in formations above the Ellenburger that indicate that Pre-Permian production may include several pays, and possibly cover a fairly extensive area.

It lies about 4½ miles north of the nearest Devonian production, which thus far, still looks as though it were on a separate structure. The Ellenburger was dry in two tests in the south producing area, and is some 800 to 900 ft. lower than the Ellenburger producers in the field proper.

Some regional maps of the hypothetical Ellenburger tops indicate a definite saddle between the Fullerton field proper and the Fullerton Devonian production to the south, rating the south production as a separate high. However, the control data is too meager to consider this as definite. Still, the odds are that the structures will be separate, even though some optimists feel there is a chance that the good show in the Devonian in 342-A Wilson do give a chance for Devonian production to connect up.

Most geologists feel that the results in 342-A are rather an indication that the Fullerton field proper may prove to be a substantial Pre-Permian producer in several pays, and possibly cover a fairly large area, as does the Permian production. If it follows the usual pattern of substantial Pre-Permian fields, it will mean Ellenburger production on top of the (Pre-Permian) structure which will probably not conform exactly with the Permian structure. Then there will probably be an overlap zone on the flanks, where both Devonian and Ellenburger will produce, and farther down dip, production only from the Devonian, with the Ellenburger carrying water.

If the Simpson should have some well-developed sands, there might well be a zone of Simpson production; and there is always the prospect of Silurian production. While the Silurian has not yet developed any substantial production in any of the West Texas fields, it has been shown that it carries oil in places, and not enough testing has been done to discount it as a potentially large producer in some spots.

In the area south of the field, where the present Devonian production is found, there is still room for a fairly good-sized Pre-Permian field. With the Rocky Mountain type structures that are found in the Pre-Permian in this whole region, good-sized structures may be found fairly close together, with their axes of folding at sharp angles to each other. Therefore the southern production could develop into a good-sized field with the trend of production veering sharply away from connecting up to the main Fullerton field.

APPALACHIAN FIELD

Westmoreland County Test Dry Through Oriskany

PITTSBURGH. — In Fairfield Township, Westmoreland County, southwest Pennsylvania, Peoples Natural Gas Co. drilled to 8,174 ft. in the wildcat on Camilla Giffin farm, or 884 ft. below the base of the Oriskany sand, without striking any signs of gas in the top of the Silurian. It is being abandoned. In Unity Township, Railway Steel Spring shut down to test casing in the Oriskany test on L. C. Steiner farm and the 148,000 cu. ft. gas in the sand at 8,006-09 ft. rocked up to 2,475 lb. It resumed drilling at 8,072 ft.

On Chestnut Ridge in Georges Township, Fayette County, Manufacturers Light & Heat Co. topped the Tully lime at 6,345 ft. in No. 7 Barton from a surface elevation of 2,437 ft. It is now drilling at 6,975 ft. and nearing the Onondaga lime.

New locations in southwest Pennsylvania totaled six and were located in Armstrong, Clarion, Greene, and Washington counties.

In Ravenswood district, Jackson County, West Virginia, United Fuel Gas Co. is drilling in the Oriskany sand in the test 5,744 Homer Nelson. The Corniferous lime was placed at 4,829 ft. and the Oriskany at 4,935 ft. with 5,034,000 cu. ft. gas showing in the top of the sand. Here, the West Virginia Gas Corp. abandoned the test 537 George W. Curry after shooting the Oriskany sand. McIntosh & Grim topped the Corniferous lime at 4,998 ft. in the test Mary Vosburg and ran 5-in. to 5,010 ft.

In Birch district, Braxton County, Creed Yoak completed the test Stump & Fisher in the Big lime with about 10 bbl. oil, 40 bbl. water, and 1,000,000 cu. ft. gas from a total depth of 2,203 ft.

In the Oriskany extension to the Elk-Poca field in Big Sandy district, Kanawha County, Falling Rock Producing Co. deepened No. 77 fee and topped the Corniferous lime at 4,987 ft. and ran casing to 5,008 ft.

In Skin Creek district, Lewis County, Pittsburgh & West Virginia Gas Co. completed 8,111 Sadie V. Taylor in the Fifth sand with a final open flow of 1,000,000 cu. ft. gas, total depth 2,369 ft.

New locations in West Virginia totaled 15 and were located in Barbour, Boone, Cabell, Calhoun, Fayette, Gi. ner, Jackson, Kanawha, and Lincoln counties.

SOUTH LOUISIANA

Wildcat In Big Island Area Has Good Oil Flow

NEW ORLEANS.—Union Producing Co. et al 1 Belgard, wildcat in the Big Island area of Rapides Parish, NE NW 14-4n-3e, flowed at the rate of 30 bbl. of 39°-gravity pipe line oil hourly on a drill-stem test made through perforations at 9,714-22 ft., and 9,684-9,700 ft. Flow was through ¼-in. and ⅜-in. chokes, and developed 1,625 lb. pressure in 1 hour and 21 minutes. Bottom-hole flowing pressure was 4,125 lb. Those interested in the operation are Union Producing Co., Carter Oil Co., Phillips Petroleum Co. and M. H. Marr of Dallas who have pooled 12,000 acres in the immediate vicinity. Phillips drilled a test 5 years ago in the immediate area, which pumped a small amount of oil and water.

Sun Oil Co.'s wildcat test 1½ miles south of production in the Shuteston field of St. Landry Parish, has been completed, opening a new gas and condensate reservoir for the south Louisiana district. This is the company's 1 Darby, 6-8s-4e, which flowed an unestimated amount of gas with some condensate through a 7/64-in. choke. Flowing pressure on the tubing was 3,650 lb. and was gaged 3,700 lb., shut in. Production is through casing perforations at 9,965-85 ft., approximately 400 ft. higher than production levels in the Shuteston field to the north.

Another new gas-condensate reservoir was brought into production at Bayou Mallet in Acadia Parish by Union Sulphur Co. 1 Willie Sattler, 50-7s-1e, on the eastern side of production. Total depth is 8,902 ft. and 5½-in. pipe is cemented to 8,805 ft. Perforations were effected from 8,465-67 ft., and flowed an initial gage of 25 bbl. of 58.2°-gravity condensate with 2,500,000 cu. ft. of gas per day through a 10/64-in. choke. Flowing pressure on the tubing was 3,100 lb.

Magnolia Petroleum Co. continues extensive exploratory activities in Evangeline Parish, and has announced intentions to drill a new 13,500-ft. wildcat test on a reported separate structure approximately 4 miles southwest of its Mamou field discovery area. The new test is to be the 1 Reed Estate, 26-5s-1e, 2 miles southwest of Mamou townsite. Company tools will be used for the operation.

Two new operators broke into explorations at Mamou. A mile south of Magnolia's 1 Morein discovery well, Lyons & Prentis of Shreveport located 1 Deshotels, 8-5s-1e, which will test the deep Wilcox sands. Hassie Hunt of Shreveport will drill the test and has preliminary operations under way. The other new operator was also

from Shreveport, Delta Drilling Co., who located a wildcat test in approximately the center of Mamou townsite 2 miles west of the discovery area, and in Section 12-5s-1w. Company tools will be used and it was announced that it would be carried 13,500 ft.

Eighteen new tests were located in the South Louisiana district this week, four of which were wildcats, two in the Mamou discovery area of Evangeline Parish, one in the North Church Point area of Acadia Parish and another a confirmation wildcat at Hahnville. Seven new wells were completed on proven acreage with one new sand at Bayou Mallet, Acadia Parish, and a new gas-condensate field in the South Shuteston area of St. Landry Parish.

SOUTH LOUISIANA SUCCESSFUL WILDCATS

Terrebonne Parish: Houma gas-condensate field — Union Oil Co. of California 1 R. R. Barrow, Inc., ½ mile southeast of production, 1-17s-18e, TD 10 498 ft., gas sand 10,310-335 ft., perf. 32 holes 10,310-318 ft., estimated 2,100,000 cu. ft. gas with small amount of 56.3°-gravity condensate per day through a 5/32-in. choke, tubing pressure 3,650 lb., flowing, and 3,750 lb., shut.

Beauregard Parish: Quarter mile east confirmation oiler for Singer field—Magnolia Petroleum Co. 1 J. O. Dolby, 23-5s-11w, TD 8,132 ft., oil sand 7,638-48 ft., perf. 12 holes 7,644-46 ft., flowed 129 bbl. per day through 7/64-in. choke. Tubing pressure 1,100 lb., 45.8° gravity, gas-oil ratio 1,180-1.

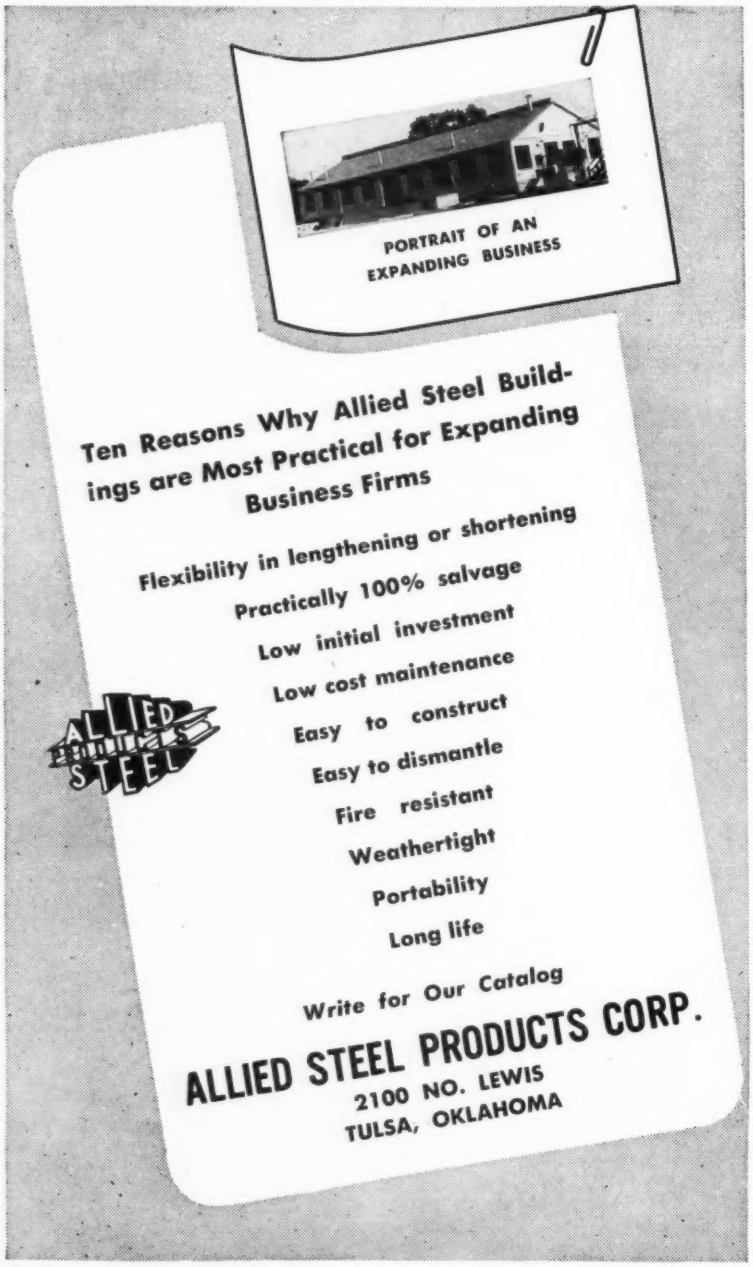
SOUTH LOUISIANA WILDCAT FAILURES

Acadia Parish: West Boscoe area—Union Sulphur Co., Inc. 1 Estate of J. D. Arceneaux Sr., Inc., 33-8s-3e, TD 11,252 ft. in sidetracked hole, tested through 20 perforations at 8,989-94 ft., showed salt water with 4,875 lb. bottom-hole pressure.

Avoyelles Parish: Avoyelles Prairie area—Avoyelles Pet. Corp. 1 R. E. Bordelon, 56-2n-4e, 3 miles north of Marksville, TD 9,017 ft., tested Neal sands in Wilcox at 7,940-43 ft., flowed salt water with 15 per cent 43-gravity oil. Also tested Sparta sands at 4,602-12 ft., flowed salt water.

Calcasieu Parish: Holmwood area—Sohio Petroleum Co. 1 Farmers Land & Canal Co., Inc., 27-10s-7w, 1½ miles north of Holmwood townsite, TD 10,618 ft., no shows.

Lafourche Parish: Lafourche Crossing northwest extension test: J. R. Meeker 1 Sidney Gaubert, 16-15s-17e, TD 12,503 ft., no shows.



SOUTHWEST TEXAS

New Producing Sand Found In Southland Field Area

CORPUS CHRISTI.—Hiawatha Oil & Gas Co. is opening a new producing sector in the southland field area at its 41 Southland Life Ins. Co., Section 17, Ball Ranch Subdivision, Agua Poquita grant. It made a good oil recovery from the Cole sand at a level higher than previous production in the field. Sand with oil odor was topped at 3,870 ft., and test at 3 874-78 ft. recovered condensate with 700 lb. working pressure in 7 minutes. Other drill-stem tests at 3,887-91 ft., 3,880-91 ft., recovered oil with a slight show of brackish water. Hole was cored ahead and found sand with oil odor at 4,501-12 ft. and a test from 4,497 to 4,501 ft. recovered condensate with 1.675 lb. pressure. Operator now coring ahead for the Teddlie sands.

The Texas Co. has set pipe at its 1 Love, wildcat about a mile southwest of Charlotte townsite, in Atascosa County, and will make a production test. On tests at 5,183-95 ft. ie recovered oil-cut mud, and another test from 5,195 to 5,220 ft. another recovery of oil-cut mud was made. Total depth is 5,355 ft., and pipe is cemented on bottom.

Southern Minerals Corp. 1 Beasley, wildcat discovery in San Patricio County, near the Bee County line and 1½ miles southwest of Tynan townsite, has been completed as a gas well with no gage of production yet. Perforations were made at 4,900-08 ft., and flowed gas on a 7/64-in. choke, with 735 lb. tubing pressure and 1,650 lb. casing pressure.

Union Producing Co.'s 64 G. A. Ray, east outpost at South Tulsita-Wilcox field, Bee County, has run potential of its oil production, extending the field more than ½ mile eastward. It flowed 162.16 bbl. oil per day on a 5/32-in. choke with 625 lb. tubing pressure and a gas ratio of 600 to 1, making 33-gravity oil with only a trace of water. Perforations were made at 7,065-70 ft., with top of the producing sands at 7,050 ft.

H. R. Smith and Skinner & Eddy Corp. 1 C. F. Wiegang, first Wilcox sand oil discovery in Atascosa County, flowed 170 bbl. of 24.5-gravity oil per day on a 5/32-in. choke with 250 lb. tubing and 350 lb. casing pressure. This discovery lies in the extreme east corner of Atascosa County.

An 8,200-ft. extension of the Jourdanton field oil production in Atascosa County seemed assured as the week closed. The well is Humble's 1 Sandeen Lot 47 Natascosa Farm Subdivision, James P. Gorman Survey No. 1189. A test at 7,370-80 ft. recovered 30 ft. of mud and 15 ft. of clean oil.

Stanolind Oil & Gas Co. 1 L. A. Regan which discovered first oil production at Oakville-Wilcox field in Live Oak County ¾ of a mile southwest of the gas-conden-

sate well, gaged its production at 92 bbl. of oil per day through an ⅛-in. choke, with 1,200 lb. tubing and 1,750 lb. casing pressure. It produces from bottom of the hole, total depth 6,738 ft., and 7-in. pipe cemented on bottom.

There were a total of 44 new locations in the Southwest Texas district in the past week, 16 of which were wildcats, and 28 proven acreage tests. The wildcats were in Bee, Bexar, Duval, Guadalupe, Hidalgo, Jim Wells, Karnes, Kleberg, Starr, Webb, Willacy, Wilson, and Zapata counties.

SOUTHWEST TEXAS SUCCESSFUL WILDCATS

Atascosa County: H. R. Smith and Skinner & Eddy Corp. 1 G. F. Wiegang, 3¼ miles northwest of Fashing, A. S. Donovan Survey, Abstract 194, top of Wilcox pay 3,758 ft., TD 3,781 ft., perf. 3,771 to 77 ft., flowed 170 bbl. oil per day, 5/32-in. choke, gas-oil ratio 140 to 1, 24.5 gravity, no water.

Starr County: Sun Oil Co. 1 Lee M. Green, 2 miles southeast of Sun field, Santa Teresa Grant, top pay 4,710 ft., TD 9,894 ft., perf. 4,729-30 ft., flowed 112.95 bbl. oil per day through ⅛-in. choke, gas-oil ratio 795 to 1, 48.3 gravity, no water.

SOUTHWEST TEXAS WILDCAT FAILURES

Bastrop County: H. F. Burkhart 1 Mary Rivers Estate, James Standifer Survey 23, dry at 2,090 ft.

Caldwell County: O. W. Killam 1 Minnie Marshall, Jos. Burleson Sur. A-3, dry at 1,100 ft.

O. W. Killam 1-A Minnie Marshall, Jos. Burleson Sur. A-3, dry at 1,944 ft.

Dimmitt County: The Texas Co. 1 Catarina Farms Co., Section 70 Catarina Farms Subd., dry, TD 4,810 ft.

Duval County: Santa Clara Oil Co. et al 1-B James F. Welder Heirs, Samuel Alexander League 102, dry, TD 2,545 ft.

F. P. Zoch, Jr. 1 Henry C. Freise et al, Lot 3, Blk. 85, 5th addition to Realitos Subdivision of Copita F & G tracts, dry, TD 5,980 ft.

Starr County: Coastal Rerfineries, Inc. 2 Chas. Rogan Estate, Sec. 7, J. A. Harvey Subdivision, Javali Grant, dry, TD 2,100 ft.

Henshaw Bros. and Coastal Refineries, Inc. 2 Sanchez, J. Poitevent Survey 343, dry, TD 5,046 ft.

Zapata County: Coastal Refineries, Inc. 1 Marrs McLean, J. A. Harvey Subdivision, E. Javali Grant, dry, TD 1,249 ft.

EASTERN TEXAS

Manziel Field May Get Sixth Producing Zone

DALLAS. — Magnolia Petroleum Co. 2 Malone-Taylor Unit, John Polk Survey, shows possibilities of opening a sixth producing horizon for the Manziel field of Wood County. A test is scheduled to be run on shows in the Woodbine from 4,785-96 ft. The field has already established production in the Travis Peak, Pettit, Rodessa and Paluxy. No field wells have been completed in the Sub-Clarksville, but two wells have shown oil in that zone on drill-stem tests; Magnolia 2 Malone-Taylor on test from 4,062-70 ft. and Lacy & Caraway 1-A J. G. Shamburger, J. M. Moore Survey, on test from 4,072-4,162 ft. Bobby Manziel and W. F. Bridwell, Jr. are drilling 1 A. L. Amasin, wildcat in the Hazard Anderson Survey, 5 miles northeast of the Merigale field in Wood County. The wildcat will test all formations through the Woodbine in drilling to about 5,600 ft.

K. L. McHenry 1 Neely, J. E. Clark Survey, Hunt County wildcat 4 miles southeast of Caddo Mills, cored from 4,795-4,810 ft. and recovered sandy shale and medium grain sand with no shows. Electrical sur-

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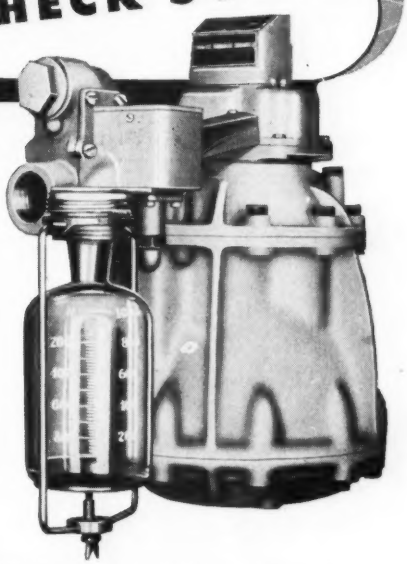

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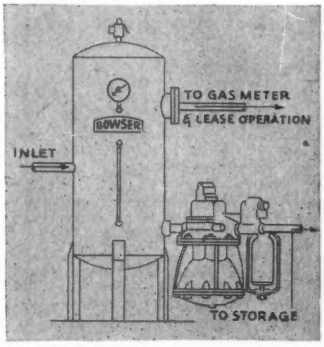

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vey was being run. C. W. Killough 1-A Bell Arnett, P. Parella Survey, wildcat 4 miles northwest of Groesbeck, Limestone County, topped the Glenrose at 4,034 ft., Pettit at 5,430 ft. and Travis Peak at 5,563 ft. Elevation is 439 ft. and total depth 5,778 ft. Operator is preparing to test the Pettit.

Carthage field, Panola County, had two completions and Smithland field, Marion County, and East Texas field had one. Marion County Shallow field had four locations and Carthage field two. Carthage field has 32 drilling wells; Hawkins field, Wood County, 16; New Hope field, Franklin County, and Sand Flat field, Smith County, each 5, and Opelika field, Henderson County, and Talco field, Titus County, each 3.

CALIFORNIA

Butte County Wildcat Has Large Gas Yield

LOS ANGELES.—Standard Oil Co. of California discovered a new gas field this week in the Chico quadrangle of Butte County and indications point to the probable existence of a commercial accumulation as the well's initial gage, 10,937,000 cu. ft. daily, was through a small bean. Standard carried this well down to 6,000 ft. for a conclusive test but subsequently plugged back to 2,200 ft. A promising sand at 5,800 ft. failed to produce, but will probably be tested out again in some future well.

The significance of this lower sand lies in that it was found in formations of Cretaceous age. Top of the Cretaceous was logged at 2,270 ft. and on this basis Standard carried this wildcat into the Cretaceous for a distance of 3,730 ft. The discovery well was drilled on fee-owned acreage in Section 6-20n-1e and since the P. G. & E. has a natural gas line between Sacramento and Chico, Standard will be able to put this new well on a substantial flow test later this year. By that time another well or two will have been completed and sufficient data acquired to permit an estimate of the amount of gas in place.

A fishing job has again delayed a satisfactory production test on the joint wildcat test being drilled by Shell for six major companies in the El Segundo-Playa Del Rey area of Los Angeles County. After several hours of swabbing without any appreciable result, the swab was lost. The crew is at present pulling tubing and it will be another several days before another production test is completed. This wildcat is bottomed in schist basement at 7,033 ft. but has been plugged back to 6,940 ft. because of salt water in the bottom of the hole. What little oil that has been recovered is in the low-gravity range, averaging around 15-17 degrees, A.P.I. Perforations are open to the formation at 6,875-6,936 ft. This wildcat is expected to show some kind of production but it appears doubtful that it will show a sustained natural flow. The present location may not be the most favorable with respect to structure and it is quite likely the next test will be directionally drilled to bottom beneath that portion of Rancho Sausal Redondo that was sold to the City of Los Angeles. The six companies retained the mineral rights.

Belridge Oil Co.'s no-dope hole in the South Belridge field was still drilling ahead at last reports and therefore the rumors that the 64-zone had been picked up have been erroneous. At 12,402 ft., the outlook remains unchanged. Belridge Oil Co. officials expected deep drilling and the landing of 8⅝-in. casing at 10,000 ft. indicates the company will continue drilling as long as the geological column is ideal and favorable. This deep test is located in Section 33-28s-21e and has an elevation of 605 ft. Richfield Oil Corp. will probably start its exploratory work at the north end of

the South Belridge field late in the year. Leasing has practically been completed and location of this projected wildcat will be made shortly.

New locations this week offset the number of completions. This balancing of operations indicates that decreases shown in other fields are being offset by increased work at Wilmington. There has been very little change in the number of drilling strings in operation although there has been a noticeable change in the location of tools. For several years, the San Joaquin Valley area proved more attractive but during the current year to date much new work has been in Los Angeles Basin. Because of the housing shortage, drilling contractors find it more advantageous to localize operations as far as possible. This permits greater efficiency and lifts the morale of field men.

CALIFORNIA WILDCAT DISCOVERY

Butte County, Durham area: Standard 1 Donohoe fee, 6-20n-1e, flowed 10,937,000 cu. ft. dry gas, no oil, TD 6,000 ft., gun perf. casing 2,140-2,200 ft., Basalt 1,383-1,549 ft., top Eocene 1,549 ft., Capay sand 2,000-2,140 ft., top Cretaceous 2,270 ft., name assigned field is tentative and may be changed by A.A.P.G. nomenclature committee.

CALIFORNIA WILDCAT FAILURES

Kern County, Kern Front: Gene Reid Drilling Co. 1 Lorraine, 2-28s-27e, bottomed in granite basement, top granite 5,859 ft., TD 5,875 ft.

Mountain View: L. S. Gilmour 37 McKendree, 11-30s-28e, bottomed in hard gray sand, oil sand was barren, only minor showings, TD 4,810 ft.

Tejon: Richfield 65-7 Tejon A, 7-11n-18w, bottomed in barren gray sand, only minor showings, TD 4,283 ft.

Orange County, Huntington Beach: A. W. Lyddon 1 Lamb Comm., 6-6s-10w, bottowed in gray sand, had some oil shows but not commercially productive, will drill second well in area on basis of showings in this well, TD 7,992 ft.

MICHIGAN

New Fields Opened In Two Counties

SAGINAW, Mich.—Reporting 22 completions in the past week, operators listed 10 producers, including 3 in Arenac County's Deep River field, accounting for the bulk of initial new potential, and 2 small wildcat wells, 1 in Genesee County, the other in Van Buren.

The state conservation department approved oil and gas leases on 23,000 acres of state-owned land, including one narrow tract bordering Saginaw Bay where conservationists and oil men engaged recently in bitter controversy over pollution possibilities.

MICHIGAN WILDCAT PRODUCERS

Genesee County, Forest Township: Hugh H. Heinig 1 Arlie Wint, SW SW SE 12-9n-8e, swabbed and pumped 10 bbl. per day, acidized, in Berea formation, TD 1,497 ft.

Ogemaw County, Klacking Township: United Drillers & Producers, Inc. 1 Carl Anderson, NW NW NE 11-23n-2e, 19 bbl. acidized, TD 4,000 ft.

Van Buren County, Columbia Township: W. D. Gannett 2 John Chamberlain, NW NW SW 17-1s-15w, pumping 75 bbl. daily with salt water, acidized, TD 1,122 ft. in Traverse limestone.

MICHIGAN WILDCAT FAILURES

Allegan County, Gun Plains Township: C. W. Kendall 1 John Nyberg, SW SE SW 28-1n-11w, dry in Traverse limestone, TD 1,481 ft.

Manlius Township: Clyde B. Miller No. 1, NE NE NW 20-3n-15w, dry in Traverse limestone, TD 1,387 ft.

Gratiot County, Elba Township: Arthur E. Williams 1 Jo Cmiko, SW SE SE 23-9n-1w, dry in Dundee, TD 2,995 ft.

Newaygo County, Barton Township: Panhandle Eastern Pipeline Co. 6 Muse, C SE 12-16n-11w, dry, TD 1,338 ft.

Norwich Township: Michigan Consolidated Gas Co. 1 Arnold, C NW 1-15n-11w, dry, TD 1,341 ft.

Van Buren County, Geneva Township: Harris Oil Co.-Del Fortney 1 Gus Heinz, SE SE SE 30-1s-16w, dry in Traverse limestone, TD 1,021 ft.

Waverly Township: J. W. Lang Co. 1 William Meachum, SW SW SE 5-2s-14w, dry in Monroe, TD 1,590 ft.

Isabella County, Denver Township: Cities Service Oil Co. 1 Lattimore, SW NE NE 3-15n-3w, dry, TD 1,344 ft.

TEXAS GULF COAST

New Field in Prospect For Wharton County

HOUSTON.—A new Wharton County oil field was indicated this week by Lakeview Oil Co. (Superior Drilling Co.) 1 J. E. J. Johnston, south of the Lake View gas field and in I&GN Survey, Section 22, Abstract 240. Production pipe had been cemented to 4,700 ft. and on an initial test through perforations at 4,520-25 ft. it flowed oil, but salt water broke in. An attempt is being made to shut off the water encroachment.

New oil production is also indicated off

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the southwest flank of the High Island dome in Galveston County. The test, Stanolind Oil & Gas Co. 1 State Land, Tract No. 2, a directional hole job bottoming under the Gulf of Mexico, is preparing to plug back for completion after drilling and coring to a total depth of 6,990 ft. A test made in sand from 6,430-35 ft. developed 100 lb. pressure and when tool was pulled it recovered 185 ft. oil and gas-cut mud with 920 ft. of clean 37.8°-gravity oil, no evidence of salt water.

A calculated open flow of 105,000,000 cu. ft. of gas per day was credited to Sun Oil Co.'s wildcat completion 8,300 ft. south of the Gilbert Ranch discovery in Jefferson County. The new well is No. 2 Gilbert Ranch which was shut in early last month after completion with no gage. It flowed on a ¼-in. choke at a gage of 3,248,000 cu. ft. of gas with 80 bbl. 53.3°-gravity colorless condensate. Flowing pressure on the tubing was 3,195 lb. and 3,280 lb. shut in. It produces from sands at 8,737-42 ft. Total depth of hole is 9,300 ft.

Moore & Ahern's 1 E. A. Clement et al, east extension gas well at Texana field, Jackson County, was gaged at 3,032,000 cu. ft. gas per day through a ¼-in. choke with 2,055 lb. tubing pressure. It has an estimated open flow potential of 47,000,000 cu. ft. of gas per day. Flow is from perforations at 5,595-5,604 ft. with total depth 6,823 ft. and 5½-in. pipe set at 5,660 ft. It extends production 3,300 ft. eastward.

Seven new wildcats were located this week, one in Jackson County, two in Lavaca County, and one each in Wharton, Chambers, Harris, and Jefferson counties. Five new producers were brought in on proven acreage.

TEXAS GULF COAST SUCCESSFUL WILDCATS

Jackson County: 3,300-ft. extension, Texana —Donald W. Moore and T. J. Ahern 1 E. A. Clement et al, Lot 17 Clement Subdivision of Steven F. Austin two-league grant, TD 6,823 ft., top sand 5,595 ft., 5½-in. casing 5,660 ft., perf. 5,595-5,604 ft., PT 34,000,000 cu. ft. gas per day open flow, 3,032,000 cu. ft. per day through ¼-in. choke, TP 1,825 lb., flowing 2,130 lb., shut in.

Jefferson County: Gilbert Ranch wildcat—Sun Oil Co. 2 Gilbert Estate, 8,370 ft. south of No. 1 Gilbert discovery gas-condensate well, Sara Miles Survey, TD 9,300 ft., top sand 8,727 ft., 7-in. pipe 8,650 ft., 5-in. liner 8,517 to 9,300 ft., perf. 60 shots 8,727-42 ft., PT 105,000,000 cu. ft. gas per day calculated open flow, or 3,248,000 cu. ft. gas and 80 bbl. 53.3°-gravity condensate per day through ¼-in. choke, TP 3,195 lb. flowing and 3,280 lb. shut in.

TEXAS GULF COAST WILDCAT FAILURES

Austin County: Orange Hill area—The Ohio Oil Co. 1-B Orange Hill Unit, H&TC Survey, Section 209, Abstract 226, TD 9,748 ft., dry.

Chambers County: High Island southeast flank wildcat—John W. Mecom 1-B Cade et al, C. T. Cade Survey, TD 6,592 ft., dry.

Jackson County: Northwest LaWard wildcat—John B. Coffee 1 W. L. Hodges Estate, Block 48, LaWard Farms first Subdivision I&GN Survey No. 7, TD 5,263 ft., dry.

Ganado area wildcat: Humble O. & R. Co. 2-C A. A. Egg, Morris & Cummings Sur. No. 25, TD 12,206 ft., stuck drill pipe, dry.

Matagorda County: Matagorda Bay wildcat—The Salt Dome Oil Corp. 1 State, Section 159, Matagorda Bay, NE of Port O'Connor, TD 5,996 ft., dry.

Markham southeast flank test—Lee Brothers & Shuart et al 2 C. M. Hudson et al, Lot 15, Henry Parker League, TD 3,734 ft., dry.

Montgomery County: Northeast Conroe wildcat—McKay Donkin and Lloyd H. Smith 1 C. L. Rawson, William Starrock Sur., TD 10,005 ft., top Wilcox 7,876 ft., dry.

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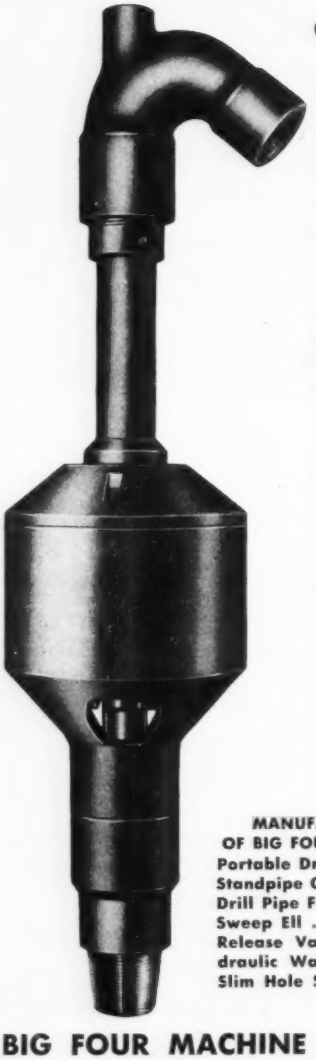

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CANADIAN FIELDS

Transportation May Hinder Development at Fort Norman

CHATHAM, Ont.—Transportation difficulties preclude the possibility of commercial development of the Fort Norman field on the Mackenzie as a major Canadian source of oil, according to a statement made by Dr. J. S. Stewart, head of the Geological Survey of Canada. In Edmonton recently, enroute north on an inspection tour of geological survey parties, Dr. Stewart said there was not the volume of oil in the Fort Norman field to warrant export in quantity, although the field would meet the needs of the north country for years. Dr. Stewart stated the Turner Valley field was slowly being worked out, but it was hoped a new field would be opened in southern Alberta.

Turner Valley.—Drilling operations in Turner Valley have reached a new low. Two tests by Home Oil are nearing the limestone. Home 22, LSD 16, 32-20-3w5, is in Fernie shale below 8,323 ft. with brown sand at 8,190 ft. and Home 23, LSD 7, 5-21-3w5, is in lower Blairmore below 7,777 ft. with Home sand marker at 7,610 ft. Both are exploratory tests. Royalite Lowery 6, LSD 16, 10-20-3w5, is below 6,430 ft. and Foothills Oil & Gas 25, LSD 6, 9-21-3w5, is starting. In the old South Turner Valley field, West Flank 2, cleaning out after a 5,000-qt. shot last February, is below 6,579 ft. and changing to cable tools before drilling the final 140 ft. to open up the area of the shot.

Stolberg.—In the Central Alberta foot-

hills, Imperial-Shell-Stolberg 1, LSD 3, 22-41-14w5, has reentered the Madison limestone at 12,826 ft. The first lime contact was at 12,218 ft., the well faulting back at 12,447 ft. The test is expected to go below 12,955 ft., the previous record depth for Alberta attained last year by Imperial-Coalspur 1.

Jumping Pound.—On the Jumping Pound structure west of Calgary, Shell 16-14-J, LSD 16, 14-25-5w5, bottomed at 10,365 ft. with Madison contact at 10,335 ft., has decided to sidetrack 248 ft. of drill pipe lost in a drill-stem test of porosity encountered in the top of the limestone.

Steveville.—In the south end of the Steveville - Princess field, South Princess Syndicate 1, LSD 9, 28-19-12w4, finished at 3,457 ft., about 100 ft. in the Devonian limestone. The overlying Sunburst sand and the limestone were both tight, and oil shows in the Devonian proved noncommercial. The second in a series of tests sponsored jointly by seven companies headed by California Standard is spudding in LSD 4, 4-19-11w4, east and south of No. 1.

Provost.—In the Provost area, eastern Alberta, Imperial Oil is undertaking systematic development, following the discovery of 28-gravity crude in Imperial-Provost 1, LSD 3, 27-37-3w4. Imperial-Provost 2, LSD 1, 35-37-3w4, is spudding and No. 3 has location in LSD 6, 27-37-3w4, ¼ mile north of the discovery well.

Kinsella.—Following the discovery of 30-gravity oil in the Viking sand in Imperial-Kinsella 14 while drilling for gas, Imperial Oil is testing the oil possobilities of adjacent acreage. No. 19, LSD 10, 28-45-9w4, has been spotted ¼ mile north of No. 14, as a test for oil. The discovery well was abandoned through failure to isolate the oil after casing off earlier gas and water sands, but initial drill-stem tests showed a rise of 400 ft. of 30-gravity crude with the rotary mud. Imperial-Kinsella 17, LSD 7, 14-46-11w4, is finishing at 2,176 ft. as a gasser in the Viking sand.

PERMIAN BASIN

Second Ellenburger Well Completed at Fullerton

MIDLAND.—Fullerton Oil Co. 342-A H. M. Wilson, Section 16, Block A-32, Public School Lands, second producer in the first Ellenburger producing area in the Fullerton field in northwestern Andrews County, flowed 107 bbl. of oil during the last hour of a 9-hour test. Flow followed treatment with 6,000 gal. of acid from 9,783-9,890 ft. The test was made after the oil load and acid residue had been recovered. The well was being drilled ahead, scheduled to explore the Ellenburger to the water. The test is ½ mile east of Fullerton 322-A Wilson, the discovery.

The Texas 1-P University, Section 15, Block 12, University Lands, indicated discovery from the Tubb zone of the Clear Fork i n southwestern Andrews County northwest of the Martin pool, was swabbing an average ½ bbl. of oil hourly The oil came through perforations in 7-in. casing from 7,170-7,250 ft. Operator was preparing to acidize.

Texas Gulf Producing Co. 1-3 Forest-University, Section 17, Block 19, University Lands, southern Andrews County wildcat 2½ miles north of the Clabberhill pool, is considered dry after 1-hour drill-stem test of the Holt from 5,587-5,712 ft. recovered 300 ft. of drilling mud and 700 ft. of sulfur water with no shows of oil or gas.

Warren Petroleum Corp. and F. T. Morrow 1 Mrs. Ruby Russell et al, Section 18, AB&M Survey, Abstract 14, Menard County discovery 14 miles west of Menard, swabbed from 60 to 70 bbl. of 32°-gravity oil and a little water in 24 hours from 2,281-90 ft. in the Canyon. It is being put on pump. The company has staked 2 Rus-

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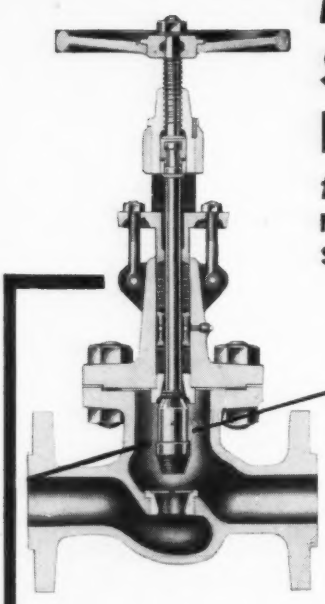

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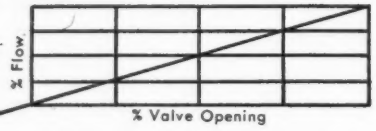

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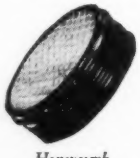

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sell 1,331 ft. west of the discovery. It is 664 ft. from the north line and 2,034 ft. from the east line of Section 18, S. Wallick Survey.

Humble Oil & Refining Co. will drill a 10,000-ft. rotary wildcat on the Bar S Ranch of the Sawyer Cattle Co. in southeastern Reagan County. The test will be 1-C Sawyer Cattle Co., 660 ft. from the south line and 1,980 ft. from the west line of Section 130, Block 1, T&P Ry. Co. Survey. It is 9.6 miles northeast of Big Lake and 3½ miles west of the Irion County line.

Humble 1 R. S. Cowden, Section 3, Block 45, T-1-N, T&P Survey, has insured a ¾-mile south extension to the North Goldsmith (Devonian) field when it recovered an estimated 35 bbl. of 36°-gravity sweet oil on a 90-minute drill-stem test from 7,971-8,049 ft. Humble has staked a 9,500-ft. wildcat 2¼ miles northeast of Humble 1 Cowden. It is 1-B Cowden et al, 660 ft. out of the northeast corner of Section 11, Block 45, T-2-N, T&P Survey. Cities Service Oil Co. 1 J. E. Parker, Section 20, Block 44, T-2-S, T&P Survey, deep test 1¾ miles west of the Harper (San Andres) pool of Ector County, prepared to set 5½-in. casing to 12,529 ft., total depth, to shut off sulfur water and test the top of the Ellenburger through perforations.

TXL-Devonian field, Ector County, had four completions, Block 31, Crane County, three, and TXL-Ellenburger field, Ector County; Keystone-Ellenburger field, Winkler County, and North Ward Estes field, Ward County, two each. Garza field, Garza County, had nine locations; Iataan-E. Howard, Howard County, six; TXL field, five, and Sharon Ridge, Scurry County, four. TXL field has 33 drilling wells; Fullerton field, Andrews County, 26; Keystone-Ellenburger field, 24; Welch field, Dawson County, 16; Keystone-Holt field, Winkler County, 8, and Martin field, Andrews County; Todd Deep field, Crockett County, and Block 31 field, each have 6.

WEST TEXAS WILDCAT FAILURES

Andrews County: Skelly 1-Z University, Sec. 10, Blk. 11, University lands, 2 mi. W Embar pool, elev. 3,331 ft., Silurian 7,995 ft., Simpson 8,805 ft., McKee 9,139 ft., dry, TD 9,212 ft.

Skelly 1-A University-Texas, Sec. 3, Blk. 11, University lands, 2 mi. NW Embar pool, elev. 3,325 ft., dry, TD 7,883 ft.

Skelly 1-B University-Texas, Sec. 10, Blk. 11, University lands, 1 mi. W Embar pool, elev. 3,306 ft., dry, TD 6,875 ft.

Ector County: Stanolind 1 Williamson, Sec. 5, Blk. 45, T-1-N, T&P Sur., NW of Goldsmith pool, elev. 3,302 ft., Montoya 9,060 ft., Simpson 10,117 ft., Ellenburger 10,198 ft., dry, TD 10,290 ft., completed to pump 28 bbl. day in regular Goldsmith field pay at 4,300 ft.

Garza County: Plymouth Oil 1 J. B. Slaughter Est., Sec. 32, Blk. 2, T&NO Sur., 9½ mi. W Justiceburg, dry, TD 4,506 ft.

Pecos County: Bryce McCandless, 1-111 Atlantic, Sec. 111, Blk. 11, H&GN Sur., 1 mi. N McCandless pool, elev. 2,398 ft., dry, TD 4,522 ft.

Sterling County: Humble 1 Lulu C. Harris et al, Sec. 114, Blk. 6, H&TC Sur., 11 mi. SW Water Valley, elev. 2,350 ft., Ellenburger 7,955 ft., dry, TD 8,402 ft.

Terry County: J. D. Hunter et al 1 P. Pool, Sec. 4, Blk. B-14, C&M Sur., 12 mi. N Tokio, elev. 3,552 ft., San Andres 4,300 ft., dry in Clearfork, TD 5,163 ft.

SOUTHEASTERN NEW MEXICO

HOBBS. — Sun Oil Co. will deepen a pumper on the north side of the Hobbs field in east central Lea County completed in March 1938 at 4,215 ft. It is 1-B McKinley, 2,310 ft. from the north and east lines of 28-18s-38e. It is scheduled to be deepened to 8,000 ft., indicating it will explore the Ellenburger. One new test is to be drilled and two deepened to around 6,600 ft. for Yeso (Clear Fork) pay outside production from that area on the northwest and northeast sides of the Drinkard field in eastern Lea County.

Amerada Petroleum Corp. 1 Hare, 33-21s-37e, one location west of the most westerly Drinkard well, will be deepened from 3,760 ft. Magnolia Petroleum Co. 6 E. O. Carson, 33-21s-37e, north of production and 1 mile west of Eunice, will be deepened from 3,780 ft. Humble Oil & Refining Co. 4-B Hardison, 34-21s-37e, northeast of the Drinkard field, is the new operation. Humble 1-B Federal-Leonard, 12-26s-37e, deep test ¼ mile north of the Ellenburger discovery of the Dublin pool of eastern Lea, recovered 2,100 ft. of salty sulfur water on a test through perforations from 5,168-5,440 ft. It was drilled to 12,585 ft. where it failed in the Ellenburger. It was plugged back for tests up the hole but failed to develop production and operator is preparing to abandon.

Square Lakes field, Eddy County, and Drinkard field, Lea County, each had two completions. Drikard field had three locations. Drinkard field has 17 drilling wells; Paddock field, 15; Square Lakes field, 10; Grayburg-Jackson field, Eddy County, 5; and Brunson field, Lea County, 5.

N. CENTRAL TEXAS

Young County Discovery Completed for Large Flow

WICHITA FALLS.—Davis & Jennings 1 Baldwin & Lovett, Section 207, TE&L Survey, Mississippi lime discovery 4 miles southeast of Olney, Young County, has been completed to flow 476 bbl. of 44°-gravity oil in 24 hours through 10/64-in. choke. Production is through perforations from 4,841-60 ft. Flowing casing pressure was 910 lb. and tubing pressure 670 lb. Two miles southeast, A. R. Dillard 1 Marietta Killiam, Section 211, Abstract 458, another Mississippi discovery, 5 miles south of Olney, has been completed to flow 280.25 bbl. of oil daily through 1-in. choke. Gas-oil ratio was 250 to 1. Casing pressure was 600 lb. and tubing pressure 100 lb. Dillard 2 Killiam, offsetting the new discovery, is drilling below 3,010 ft.

The Texas Co. 2 J. R. Handy, Samuel Stewart Survey, Abstract 1069, wildcat 10 miles northwest of Gordonville, Grayson County, encountered sand showing oil at 1,665-98 ft. It is standing after setting 5½-in. casing. Standard Oil Co. of Texas 1 Mitchell, J. B. McNair Survey, deep test 1½ miles northwest of Sherman, Grayson County, is fishing for bit cones at 9,790 ft.

National Associated Petroleum Co. 1 Davenport, Section 112, Block 14, H&TC Survey, northeast offset to 1 Schmoker, recent Canyon discovery in Wilbarger County, topped the Canyon at 3,540 ft. It was drilled to 3,548 ft. A 15-minute drill-stem test recovered 30 ft. of mud with no shows. It was drilling below 3,910 ft. National Associated 1 J. E. Lockett, Section 27, Block 9, H&TC Survey, 1 mile south of Lockett and 2 miles west of 1 Schmoker, topped the Canyon at 3,541 ft. and was shut down for repairs at 3,725 ft.

Gatewood field, Cooke County, and Electra field, Wichita County, had four completions this week and East Holliday field, Archer County, and Sivell's Bend field, Cooke County, had two. Wilson field, Cooke County, had three locations, and Lawson-Rose field, Haskell County, had two. Nocona field, Montague County, has seven drilling wells; National field, Wilbarger County, six; Cooper field, Archer County, and Wilson field, Cooke County, five each and Ross field, Clay County, and Rose field, Haskell County, each four.

In West Central Texas Lewis Steffins field, Jones County, had one completion. Crosscut field, Brown County, and Shackelford County Regular field each had one location. Eolian field, Stephens County, has four drilling wells; Silver Valley field, Coleman County, and Sanders field, Shackelford County, each three and Palo Pinto Regular field and Loving field, Stephens County, each two.

NORTH CENTRAL TEXAS WILDCAT FAILURES

Archer County: Clyde Gibson 1 Luke W. McCrory, Lot 1, Blk. 55, ATNCL Sur., 1½ mi. N and 2 mi. W Luke Wilson, elev. 1,026 ft., dry, TD 4,816 ft.

Clay County: J. P. Owens 1 T. S. Adams, Blk. 148, Byers Bros. Subd. 1 mi. W and 2 mi. N Byars, elev. 883 ft., Ellenburger 3,133 ft., dry, TD 3,217 ft.

Cooke County: A. E. Hudspeth 1 Mary Reiter, Lot 7, Geo. M. Casey Sur., 4 mi. N and 2 mi. W Muenster, dry, TD 1,725 ft.

Cottle County: W. H. Peckham et al 1 Wiley, A. A. Neff Sur., 5 mi. E and 12 mi. N of SW corner of county, dry, TD 6,007 ft.

Grayson County: H. W. Snowden 1 A. M. Bryant, E. M. Jones Sur. A-623, 1 mi. N and 2 mi. W Whitewright, elev. 782 ft., dry, TD 4,430 ft.

Jack County: Continental 1 Durham & Kempner, Chas. O'Conner Sur. A-454, 1½ mi. E and 2 mi. S Cundiff, elev. 948 ft., Ellenburger 6,532 ft., dry, TD 6,660 ft.

Young County: R. J. Watson et al 2 H. H. Jones, Sec. 254, TE&L Sur., 3 mi. E and 1 mi. S. Olney, elev. 1,159 ft., dry, TD 620 ft.

WEST CENTRAL TEXAS WILDCAT FAILURE

Coleman County: Hightower Oil & Refg. Co. 1 McCreary, Subd. 35, Joseph Martin Sur., 3 mi. NE Rockwood, elev. 1,476 ft., Caddo 1,487 ft., dry, TD 1,645 ft.

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ROCKY MOUNTAIN

Two Cut Bank Area Wells Showing Oil in Madison

DENVER.—Two wells in the Cut Bank area, widely separated, warranted attention this week when they found shows of oil in the Madison lime. Consolidated Gas Co. 2 State, SE NW NE 16-35n-4w, an outpost west of the Kevin-Sunburst field and 10 miles southeast of Union Oil Co. 1 Stufft, the nearest Madison lime producer in Cut Bank, had the Ellis-Madison contact at 2,365-67 ft., and was drilled to 2,467 ft. A bailing test showed oil at the rate of 3 to 4 bbl. per day, the oil being light amber in color and approximately 48.9° gravity. There was no water with the oil. It is preparing to acidize and test. Another report puts the top of the Madison at 2,457 ft.

Twenty-one miles south of Union's 1 Stufft, the nearest Madison producer, Castle-Pardee 4 Tribal, NW NW NE 13-32n-6w, an outpost in the Cut Bank sand, which was dry at 3,000-25 ft., topped the Madison at 3,191 ft., and had a show of oil. It will be acidized. Whether it will make a well is not yet apparent. It is the first Madison test in that part of the field. Union Oil Co. 2 Stufft, C SW NE 19-36-5w, east offset to 1 Stufft, had the top of the Madison at 3,015 ft., with a show of gas at 3,050-60 ft., and 18,000,000 cu. ft. at 3,050-65 ft. It had oil at 3,100-06 ft. (total depth), and swabbed 124 bbl. first 24 hours before acidizing. Carter Oil Co. 2 Brindly, C NW NW 12-36-6w, a near completion, acidized with 1,000 gal. at 3,118-28 ft., 1,000 gal. at 3,130-41 ft., and flowed and swabbed 252 bbl. of acid water in 24 hours.

Republic National Bank *of* Dallas

Statement of Condition June 29, 1946

RESOURCES

Loans and Discounts		$132,089,423.09
Banking House		1,930,999.31
Furniture and Fixtures		280,803.49
Real Estate for Bank Expansion		489,503.87
Stock in Federal Reserve Bank		600,000.00
U. S. Government Securities		68,076,249.40
Other Bonds and Securities		212,746.31
Cash and Due from Banks		76,830,700.40
Total		$280,510,425.87

LIABILITIES

Capital	$ 10,000,000.00	
Surplus	10,000,000.00	$ 20,000,000.00
Undivided Profits		2,001,915.43
Reserve for Dividend, Payable July 1, 1946		200,000.00
Reserve for Taxes, Etc.		1,746,891.36
DEPOSITS:		
Individual	$139,017,238.49	
Banks	84,066,548.18	
U. S. Government	33,477,832.41	256,561,619.08
Total		$280,510,425.87

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Rooth well at Rangely.—Continental Oil Co. 2 Rooth, C SW SW 15-2n-103w, west side of Rangely field which found oil in the Shinarump at 6,060-6,100 ft. and flowed better than 5,000 bbl. before the tubing sanded up, pulled the string to clean out and reran it. Oil in the hole was swabbed down and in a few hours sulfur water broke in. It is believed this was Sundance sand water. Retainer was set at 5,919 ft., and plug was set around the shoe in an effort to shut off the water.

Pure well at Worland.—Pure Oil Co. 3 Unit, NE SW SW 17-48n-92w, River Dome, Washakie County, Wyoming, a mile to the southeast of 1 unit, the discovery well in the Embar, in a drill-stem test in the Frontier at 7,253-80 ft., open 1 hour and 17 minutes, was estimated at 10,000,000 cu. ft. of gas and 30 bbl. of condensate. Top first Frontier was at 7,156 ft., second at 7,256 ft., and third at 7,428 ft.

Beaver Creek showing distillate.—Stanolind Oil & Gas Co. 3 Unit, NW NE 14-33n-96w, Beaver Creek gas field, Fremont County, Wyoming, had the top of the third Frontier at 7,776 ft., and is drilling at 8,208 ft. in shale. A drill-stem test at 8,094-8,136 ft., open 3 hours and 55 minutes, recovered a steady flow of gas. One hour was required to unload the water cushion, and the well blew dry gas for 10 minutes, estimated recovery being 2,300,000 cu. ft., and 2½ stands of distillate, with 3 stands of cushion. This is the third well on the structure, ¾ of a mile southeast of 2 Unit and 1½ miles southeast of the discovery. This is the first report of any of the wells showing distillate, the other two being gas wells.

New operations.—Nineteen new operations were reported, of which 2 were in Colorado, 5 in Wyoming, and 12 in Montana. The Colorado locations were one each in Rangely and at Lake Creek, the latter being a wildcat in Jackson County. The Wyoming locations were one each at Beaver Creek, Gebo, Spence and Osage, and a formation test well in South Sand Draw. Last named is Sand Draw Oil Co. 1 Unit, SE NE NE 26-32n-95w, located 2 miles southeast of Sinclair-Wyoming Oil Co. Tensleep sand discovery well. Big Sand Draw structure is concealed by flat-lying beds of the Wind River formation of Tertiary age, and there always has been some question as to just where the axis is located. Two weeks ago Sinclair-Wyoming 3 Unit had a blowout in the Embar, that horizon running 311 ft. higher than the discovery. The Sand Draw Oil Co. test will be drilled to 2,500 ft. with slim hole rotary to determine in which direction the axis trends in the south end of the field. The company has a 3,500-acre unitized block and test is preliminary to drilling a deep well.

The Montana locations included one each in Kevin-Sunburst, Hardin and Pondera, two in Cat Creek, five in Cut Bank, and two wildcats. One of the wildcats is especially important, this being H. L. Hunt 1 Kendrick Cattle Co., SW SE SE 24-1n-34e, Nine Mile district, Big Horn County. Between 50 and 60 shallow gas wells have been drilled in the Hardin district in the past few years. They come in for 30,000 to 70,000 cu. ft. of gas per day from a thin sand found at 400 to 700 ft., believed to be in the Frontier formation. A deep test in the center of the area went to 4,120 ft. without discovering anything under the gas sand. The conclusion has been that the sand either is lenticular or that the gas is seeping from some other source. North of this area is the well-known Lake Basin-Huntley fault zone, a belt of an echelon faulting that extends across Big Horn County from the northwest corner of T. 1 N., R. 30 E., at least as far as the Nine Mile uplift in T. 1 N., R. 34 E. While all of it has not been mapped, enough is known to show that it extends about 105 miles.

A year ago Hunt and associates, including Marcus Snyder, Texas oil man and rancher, leased up an estimated 300,000 acres in that general area, including the Kendrick ranch which extends down al-

most to Sheridan, Wyoming. Extensive geological work since has been done. A few weeks ago Mackinnie Oil & Drilling Co. drilled a test 3½ miles southwest of the Hunt location, mostly for geological information, and had the Dakota at 2,510-30 ft., the Lakota at 2,665 ft., the Morrison at 2,703 ft., and Sundance at 2,850 ft. This well temporarily is abandoned until the Hunt test, which will go to the Devonian, is completed. These two operations are east of the Big Horn River, while the shallow gas field is on the west side. Several of the major companies have blocks in the general area extending up toward the central part of the state. The other wildcat is R. C. Tarrant 1 Northern Pacific, NE NE SE 1-6n-15e, in Wheatland County.

Completions.—Seventeen wells were completed, of which 11 were oil wells with initial production of 2,612 bbl.; 3 were gas wells, and 3 were dry holes. Four of the oil wells with initial of 1,825 bbl. were in the Rangely field in Colorado. Five were in Wyoming, of which 3 were oil wells for 590 bbl., one each in Spence, Oregon Basin, and Big Muddy. Cut Bank, in Montana, had 3 oil wells for 184 bbl., Kevin-Sunburst 1 for 13 bbl., and Hardin had 3 small gas wells.

WYOMING WILDCAT FAILURES

Shawnee, Converse County: Carter Oil Co. 120-C, SW NW 9-33n-68w, TD 11,763 ft., top of Dakota 11,350 ft., slight porosity 11,570-95 ft. and 11,620-55 ft., dry.

East Bailey, Carbon County: Wasatch Oil Ref. Co. 1 Cameron Unit, SW SW SW 13-26n-89w, TD 6,972 ft., top Tensleep, 6,850 ft., dry.

MONTANA WILDCAT FAILURE

Daisy Dean, Wheatland County: R. C. Tarrant 1 Bair, SW NE NW 28-9n-12e, TD 2,050 ft., completed in red beds as water well.

OHIO, KENTUCKY

Large Gas Gage Reported For Lorain County Well

COLUMBUS.—Hanley & Bird 1 Carl Seabold, Lot 33, La Grange Township, Lorain County, gaged 1,332,000 cu. ft. natural. Five feet of Clinton was found at 2,401-06 ft. A southwest offset to the well has been approved.

Pure Oil 2 Mary Reed, Section 21, Harrison Township, Muskingum County, found the Clinton at 4,182-4,225 ft. with 504,000 cu. ft. natural. After shot the well was shutin at 1,130,000 ft.

The Industrial Gas extended their gas pool in the north part of Deerfield Township, Morgan County, ¼ mile east with a 600,000 cu. ft. well on C. C. Jadwin, Section 11. Clinton was logged at 4,280-4,316 ft.

Two producers were completed in the Hemlock Grove Berea sand pool in Meigs County. Preston Oil 1 Well, Section 33, Orange Township, made 20 bbl., and Preston Oil 4 Well, Section 33, also made 20 bbl.

Atha 3 H. H. Roberts, Section 23, Newton Township, Muskingum County, has indications of being a good producer. Clinton at 3,370-3,415 ft. had an oil show which is to be shot.

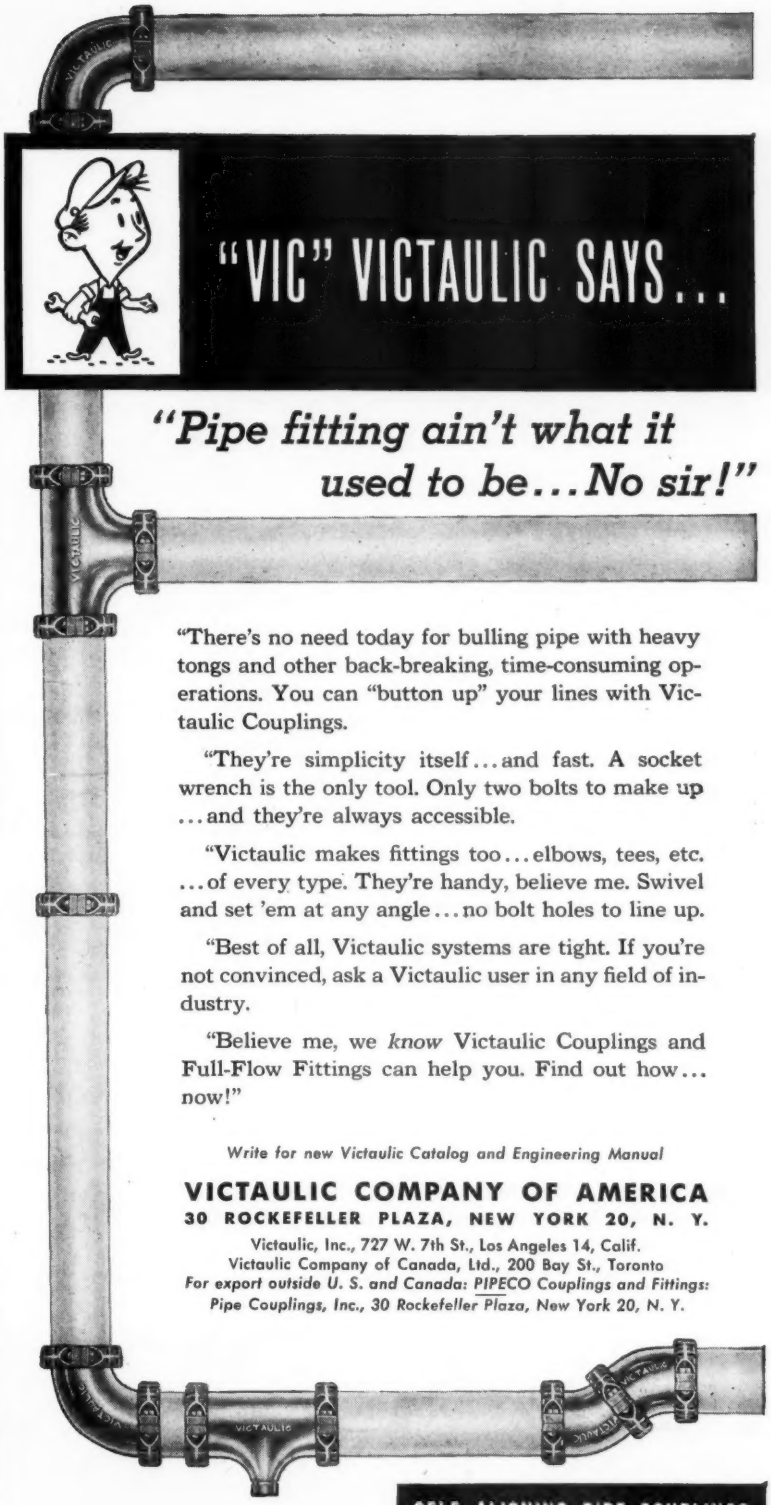
Lancaster field reported five locations, followed by Ashland, Brush Creek, and Cambridge with four each, Stewart two and Sandyville one. There were 32 completions with 8 in Cambridge and 6 in Ashland.

OHIO WILDCAT FAILURES

Muskingum County, Salt Creek Township: Wasson 1 Rosalie Echelberry, Sec. 25, Clinton 4,495-4,541 ft., Medina 4,608-15 ft., TD 4,630 ft.

WESTERN KENTUCKY

OWENSBORO.—In Henderson County the Hoosier Drilling Co. is moving in cable tools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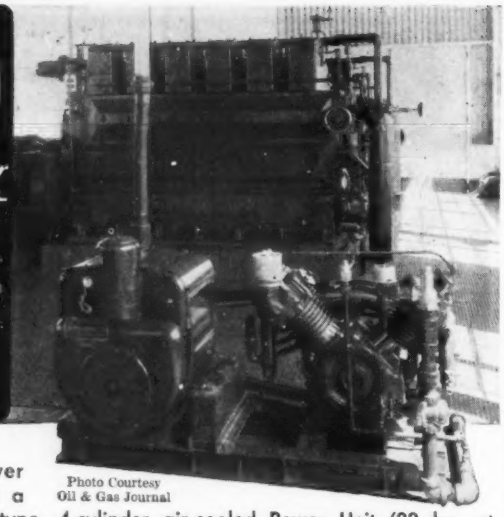

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Oil & Gas Journal

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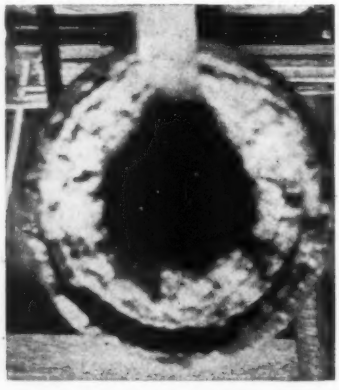

to resume drilling at the 1-D C. A. Dempewolf, NE NE NE 18-P-27. Total depth drilled with rotary is 2,015 ft. This wildcat will be taken to the Devonian, expected at about 4,200 ft.

Completions in the Western Kentucky area for the past week totaled five, of which one was an oil well and the remainder were dry. No wildcat completions were reported. New operations announced during the week included four in Henderson County, two in Union and one in Daviess.

EASTERN KENTUCKY

ASHLAND.—Kentucky-West Virginia Gas Co. reported three completions during the past week.

Well No. 5,652 on the Ben Adams property in Pike County, at 2,880 ft., brought 980,000 cu. ft.

Well No. 813 on the J. F. Burnett property, also in Pike County, at 3,435 ft., was gaged at 119,000 cu. ft. in Shale, after shot, and Well No. 5,644 on the Alamander Caudill farm, Knott County, at 3,297 ft., brought 133,000 cu. ft. in Shale and 21,000 cu. ft. in Big Lime.

INDIANA

EVANSVILLE.—Indiana exploratory tests continued to drill ahead during the past week, none of them reaching crucial stages. Completions reported for the week included three oil wells and three dry holes. One of the dry holes was a wildcat, while the remaining completions were development wells. Nine new operations were announced for Posey County, three for Gibson and two for Pike. None of these were wildcats.

INDIANA WILDCAT FAILURE

Gibson County: C. R. Craft 1 Ireland, NW NW SE 14-4s-10w, dry in 2,235 ft., Barlow 1,793 ft., Ste. Genevieve 2,027 ft., St. Louis 2,218 ft.

KANSAS

Paden's Second Zone Discovery Making Water

THE Paden pool's prospects for a second pay zone in the Viola, at Anderson-Prichard 5 Schulz, NE NW NW 15-18-1w, northeastern McPherson County, were fading with the entrance of water after a second acid treatment. With the hole bottomed at 3,156 ft., in the Viola, topped at 3,151 ft., it swabbed 4½ bbl. of oil per hour after first treatment with 500 gal. of acid. A second treatment of 1,000 gal. was made and the well swabbed 25 bbl. of fluid per hour, cutting 50 per cent water. Operators said a water survey showed that it was not Viola formation water. Further testing is halted until cement has set from resetting the oil string.

Production in the Paden pool is from the Mississippian chat. Sixteen wells in the field are producing, many of which had shows of oil in the Viola.

In northwestern Stafford County, Virginia Drilling Co. 2 Roberts, CWL SW SW 14-21-12w, which was showing as a prospective pool opener after filling 400 ft. with oil on top of some water, was making further tests this week. The hole is bottomed at 3,569 ft. in the Arbuckle, and after acidizing with 500 gal., the overnight fillup was recorded.

In Carter County, Loual Drilling Co. was reported to have finished its East Ardmore concentration, with a solid 1,000-acre block in Sections 24 and 25-4s-2e, and 19-4s-3e, with Magnolia Petroleum Co. and Will H. Smith on the flanks. Future drilling in the area will hold considerable interest since the only important development in the eastern part of the county is the Brock field in 5s-1e, some 15 miles southwest of Loual's new play.

KANSAS WILDCAT FAILURES

Barton County: Potash Co. of America 1 Weber, NE SE NW 35-19s-14w, dry, TD 3,551 ft., Kansas City 3,218 ft., with a show of dead oil at 3,220 ft., conglomerate 3,469 ft., Arbuckle 3,521 ft., with show of oil at 3,521 ft.

Marion County: S. A. Yarnell 1 Waner, SW SW NE 14-20s-4e, dry, TD 2,630 ft., Mississippi lime 2,300 ft., Kinderhook 2,414 ft., Viola 2,596 ft.

FOREST CITY BASIN

Dan Short 2 Giffen in C W½ NE NW 15-65n-40w, was a dry hole completed July 11 in Atchison County, Missouri, on the northwest outskirts of Tarkio. Elevation was 1,026 ft., total depth 1,385 ft., and sand was topped at 1,381 ft., being white with no oil stains. The operator, who has drilled four dry holes in the area, was hunting for Bartlesville sand, which is the pay in a small oil pool about 5 miles southeast of Tarkio.

ILLINOIS

Wayne County Well May Link Leech and Golden Gate

MATTOON.—The Inland Producers, Inc., 1 Kletzker, SW SW NW 4-3s-9e, has set pipe for a test of saturated Aux Vases sand at 3,273-98 ft., total depth 3,440 ft. A 1-hour drill-stem test of the Aux Vases at 3,270-3,300 ft. recovered gas in 13 minutes, 2,240 ft. of oil and 60 ft. of heavy oil-cut mud with no water. The 1 Kletzker is located about ¾ mile south of production in the Golden Gate field and nearly 1 mile north of nearest production in the Leech pool. Two other producing wells are located in Section 4, about ½ mile east of the Kletzker, and further development of the area may eventually link the two fields. Some dry holes have been drilled on the north side of the Leech field, but production also extends as far north as any of the dry holes.

George S. Engle has completed his Wabash County wildcat, the 1 Clint Guisewite, SW SW SE 23-1n-13w, for 100 bbl. daily from the McClosky lime at 2,599-2,606 ft. following an acid treatment of 3,000 gal. The well pumped 140 bbl. of oil during the first 24 hours of testing and was pumping at the rate of 4 bbl. an hour at the end of the test. The Palestine sand at 1,712-46 ft., which also showed saturation, has not yet been tested. The 1 Guisewite is located ¾ mile northeast of the Friendsville field, but dry holes between the wildcat and the producing area of the field indicate that a new area may be opened.

Illinois completions showed a decided decline during the past week with only 16 oil wells and 23 dry holes reported. Twelve wildcat tests were completed, all of them failures. New operations announced during the week totaled 52, of which 15 were wildcats. The wildcats were located three each in Wayne and Coles, two each in Lawrence and Cumberland, and one each in Marion, Richland, Perry, Jefferson, and Hamilton counties.

ILLINOIS WILDCAT FAILURES

Bond County: Leo Horton 1 C. E. Ray, SE SE SW 16-6n-2w, dry at 1,042 ft., Glen Dean 727 ft., Cypress sand 886 ft., Benoist sand 1,030 ft.

Duncan & Doran 1 Root, SE SE NE 16-6n-4w, dry at 2,735 ft., Louisiana 1,768 ft., Devonian 1,897 ft., Maquoketa 2,512 ft., Trenton 2,734 ft.

Clinton County: Hubbard 1-A Mahlandt, NW SW SE 25-3n-3w, dry at 1,580 ft., Cypress sand 1,077 ft., Ste. Genevieve 1,321 ft., Fredonia 1,351 ft., McClosky 1,373 ft.

Coles County: N. A. Cummings 1 A. M. Harrah, SE SE SE 27-12n-8e, dry at 2,406 ft., Glen Dean 1,902 ft., Cypress sand 2,052 ft., Renault 2,202 ft., Aux Vases sand 2,212 ft., Ste. Genevieve 2,246 ft., Rosiclare 2,290 ft., Fredonia 2,320 ft.

Edwards County: C. A. Lynch 1 H. Redpath, SE SW NE 19-1s-11e, dry at 3,222 ft., Waltersburg sand 2,314 ft., Tar Springs 2,410 ft., Glen Dean 2,492 ft., Hardinsburg sand 2,558 ft., Benoist sand 2,904 ft., Ste. Genevieve 3,048 ft., Fredonia 3,134 ft., McClosky 3,160 ft.

Jasper County: J. W. Menhall 1 Short, NE SW NE 14-7n-10e, dry at 2,694 ft., Glen Dean 2,068 ft., Benoist sand 2,402 ft., Aux Vases sand 2,468 ft., Ste. Genevieve 2,515 ft., Rosiclare 2,530 ft., Fredonia 2,569 ft., St. Louis 2,685 ft.

Superior 1 Al Schultz, SW SW SW 20-6n-8e, dry at 3,122 ft., Waltersburg sand 2,361 ft., Glen Dean 2,488 ft., Cypress sand 2,672 ft., Benoist sand 2,832 ft., Aux Vases sand 2,906 ft., Ste. Genevieve 2,971 ft., Rosiclare 2,990 ft.

Marion County: H. Miller 1 Coursem, SW SW SW 5-2n-2e, dry at 2,200 ft., Tar Springs 1,559 ft., Glen Dean 1,628 ft., Cypress sand 1,853 ft., Benoist 1,960 ft., Ste. Genevieve 2,042 ft., Rosiclare 2,077 ft., Fredonia 2,095 ft., McClosky 2,124 ft.

Saline County: W. P. Ford 1 J. E. McCue, NE NW NE 5-9s-7e, dry at 2,957 ft., Palestine 1,872 ft., Tar Springs 2,110 ft., Glen Dean 2,179 ft., Hardinsburg 2,304 ft., Cypress sand 2,477 ft., Renault 2,705 ft., Aux Vases 2,805 ft., Ste. Genevieve 2,851 ft., Rosiclare 2,893 ft., Fredonia 2,903 ft.

Shelby County: W. R. Britton 1 Kenzie, SW SW NW 27-11n-4e, dry at 2,040 ft., Rosiclare 1,906 ft., Fredonia 1,942 ft., McClosky 1,968 ft.

Richland County: Fleming & Swann 1 Reed, SE SE NE 27-3n-10e, dry at 3,030 ft., Glen Dean 2,636 ft., Cypress sand 2,820 ft.

White County: Olsen Drlg. Co. 1 G. C. Renshaw, SE SE SE 17-5s-9e, dry at 3,430 ft., Tar Springs 2,552 ft., Glen Dean 2,662 ft., Hardinsburg sand 2,731 ft., Cypress

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sand 2,941 ft., Benoist sand 3,086 ft., Aux Vases sand 3,204 ft., Ste. Genevieve 3,232 ft., Fredonia 3,266 ft.

OKLAHOMA

New Discovery Indicated In Cheyarha District

THE GULF OIL CORP. 1 Remaklus, SW SW NW 17-10-7e, has apparently opened a new pool in the Cheyarha district of Seminole County. On a drill-stem test of the Gilcrease sand at 3,742 ft., recovery was approximately 3,000,000 cu. ft. of gas and 10 to 20 bbl. of oil an hour. Following the test, the well was drilled ahead to the Cromwell at 3,789 ft. but this formation was hard and tight and operators elected to back up and test the Gilcrease. An electric log run before cementing casing indicated a good commercial well may be obtained in the Gilcrease at 3,725-52 ft. and 3,769-80 ft.

The eastern limit of the active Coon Creek field of Oklahoma and Logan counties was defined during the past week by the failure of Sinclair Prairie et al 1 Schmahl, NW SW SE 34-15n-1w. This well was drilled to a total depth of 5,980 ft. to test the second Wilcox sand. Salt water with no shows of oil were recovered during testing.

Carter Oil Co. 1 Patterson, SW SW SW 23-10n-6e, is showing prospects of opening production from the Earlsboro sand in the Keokuk pool of Seminole County. Fourteen feet of fine sand bleeding oil were recovered in a core from 3,454-72 ft., and 7 ft. of sand and shaly sand bleeding oil were recovered from 3,472-85 ft. Despite these shows, a 30-minute drill-stem test taken from 3,459-85 ft. showed a slight blow of air in 15 minutes and recovered only 38 ft. of drilling mud with no oil.

Magnolia Petroleum Co. 1 Spiers, SW SW 28-5n-6w, in the Chitwood pool of Grady County, found the second sand below the Cunningham producing zone when a core from 11,701-08 ft. showed 7 ft. of shaly sand with stain and odor. Operators drilled ahead, however, and topped another sand at 11,734 ft. which began heaving when penetrated only a short distance. Fearing a blowout, crew is weighting mud before continuing operations.

OKLAHOMA SUCCESSFUL WILDCATS

Creek County: Davon 1 McVey "B", NE NE NE 30-15n-7e, flowed 500,000 cu. ft. gas, Layton 1,780 ft., Cleveland 2,100 ft., Oswego 2,830 ft., Prue 2,850 ft., shaly sand 2,870-88 ft., with a show of oil, Verdigris 2,924 ft., TD 2,940 ft.

Pottawatomie County: Tom Berry, Kingery & Barker 1 Johnson, NW NW SW 27-6n-3e, pumped 34 bbl. of oil per day, Hoover sand 1,834 ft., sand 1,850 ft., TD 1,855 ft.

Seminole County: Portable 1 Campbell, SE SE SW 21-9n-7e, 4,000,000 cu. ft. gas, Wewoka 1,560 ft., Calvin 2,036-90 ft., brown lime 3,195 ft., Booch 3,264-3,310 ft., Cromwell 3,410-38 ft., TD 3,438 ft.

OKLAHOMA WILDCAT FAILURES

Beckham County: Stephens Petroleum Co. 1 Rattlesnake, NW NW NW 19-8n-26w, dry, TD 2,218 ft., cored 1,862-66 ft., dolomitic lime with slight show of oil, Granite wash 2,206 ft.

Cotton County: Smiley & Norwood Drilling Co. 1 Ray, NW NW SW 14-2s-11w, dry, TD 2,054 ft., sand 1,180-92 ft., with slight show of gas, sand 1,628-40 ft. with slight show of gas.

Kingery Brothers 1 Homovich, SW NW NW 1-4s-11w, dry, TD 1,432 ft., no tops reported.

Bridwell Oil Co. 1 L. Dike, SW NE SW 6-5s-10w, dry, TD 2,819 ft., Canyon 2,610 ft.

Okfuskee County: Porter Oil & Gas et al 1 J. W. McMahon, SE SE NW 28-12n-8e, dry, TD 3,748 ft., Layton 988 ft., Oswego

SUMMARY OF JUNE COMPLETIONS

	Comp.	Oil	Prod.	Gas	Dry	Under 1,000 ft.	1,000-2,500 ft.	2,500-5,000 ft.	5,000-10,000 ft.	Over 10,000 ft.	Total footage	Rigs and drilling
New York	118	59	133	0	*59	0	118	0	0	0	165,561	159
Pennsylvania	292	149	387	18	†125	19	249	24	0	0	451,144	241
West Virginia	65	5	44	48	12	2	26	31	6	0	195,891	214
Ohio	108	30	490	43	35	9	41	56	2	0	287,116	205
Indiana	44	27	3,308	0	17	2	37	5	0	0	83,575	66
Kentucky	52	28	2,944	8	16	12	24	16	0	0	86,924	60
Illinois	236	141	16,680	0	95	11	99	126	0	0	622,649	227
Michigan	74	18	2,326	6	50	1	39	32	2	0	175,192	118
Kansas	150	76	33,137	22	52	0	15	135	0	0	478,931	270
Neb., Mo., Iowa	1	0	0	0	1	1	0	0	0	0	173	13
Oklahoma	219	123	13,802	22	‡74	17	51	115	34	2	710,067	530
Texas	771	460	122,293	44	267	54	226	246	229	16	3,158,790	958
North	240	126	16,260	0	114	46	123	57	14	0	541,006	185
West Central	57	27	5,170	5	25	3	29	25	0	0	144,985	67
West	157	131	75,762	2	24	1	35	65	43	13	778,448	287
Panhandle	31	12	1,076	11	8	0	6	25	0	0	92,344	73
Eastern	63	45	8,422	8	10	0	11	24	27	1	339,636	120
Upper Gulf Coast	67	39	5,336	4	24	0	0	12	53	2	457,589	76
Lower Gulf Coast	92	61	8,810	12	19	0	1	13	78	0	586,945	97
South	43	14	1,107	2	27	1	14	18	10	0	149,829	24
South Central	21	5	350	0	16	3	7	7	4	0	88,008	29
Louisiana	108	67	11,926	6	35	18	27	15	22	26	694,578	193
Northern	56	37	5,148	6	13	18	26	12	0	0	210,258	96
Southern	52	30	6,778	0	22	0	1	3	22	26	484,320	97
Arkansas	17	11	1,130	0	6	4	13	0	0	0	53,333	26
Mississippi	27	15	3,567	0	12	0	0	2	18	7	206,694	43
Ala., Ga., Florida	4	0	0	0	4	0	0	2	1	1	29,252	19
Montana	40	18	1,564	10	12	5	24	10	1	0	82,822	89
Wyoming	17	13	4,030	1	3	2	1	11	3	0	69,377	72
Colorado	17	15	6,109	0	2	0	0	0	16	1	115,427	74
New Mexico	35	26	6,761	4	5	1	6	19	9	0	134,788	91
California	140	115	48,398	7	18	2	50	54	27	7	543,296	202
Oregon	1	0	0	0	1	0	0	0	1	0	7,885	0
Total June	2,536	1,396	279,029	239	901	160	1,046	899	371	60	8,354,005	3,870
Total May	2,338	1,302	263,369	192	844	134	899	888	373	54	8,197,888	3,562

Service wells, 4 weeks ending June 29, 1946: *59, †116, ‡1.

2,270 ft., Prue sand 2,335-70 ft., sand 2,505-80 ft., Verdigris 2,675 ft., Red Fork 2,885-2,940 ft., Inola 3,140 ft., brown lime 3,335 ft.

Payne County: Deep Rock Oil Corp. 1 School Land, SW SW NW 16-18n-3e, dry, TD 4,490 ft., Cushing lime 500 ft., Oread 1,695 ft., Bighart 1,880 ft., sand 2,370 ft., Layton 3,000 ft., Cleveland 3,455 ft., Oswego 3,600-3,730 ft., Prue 3,755-85 ft., Verdigris 3,800-12 ft., Red Fork 3,902 ft., Bartlesville 3,932-37 ft., sand 3,978-4,002 ft., Mississippi lime 4,162 ft., Woodford 4,265 ft., Sylvan 4,312 ft., Viola 4,355 ft., Wilcox 4,410-27 ft., dolomite 4,409 ft. and 4,427 ft., second Wilcox 4,457 ft.

Pottawatomie County: Atlantic 1 Kennedy, SW SE NE, 22-9n-3e, dry, TD 5,425 ft., Oswego 4,123 ft., Prue 4,150 ft., Earlsboro 4,485 ft., Mayes 4,720 ft., Woodford 4,808 ft., Hunton 4,998 ft., Sylvan 5,070 ft., Viola 5,159 ft., dolomite 5,251 ft., Wilcox 5,294-5,360 ft. and 5,406 ft.

Seminole County: Jack White 2 Gross, SW NW NE 12-8n-6e, dry, TD 4,154 ft., brown lime 3,160 ft., Booch 3,320-30 ft., Woodford 3,862 ft., Hunton 3,962 ft., Sylvan 3,980 ft., Viola 4,070 ft., sandy dolomite 4,145 ft.

Stephens County: Mercury Drilling Co. 1 Gentry, NE NE NE 5-1s-5w, dry, TD 3,157 ft., conglomerate 1,730 ft.

Continental Oil Co. 1 Fred Schiefer, SE NE NE 21-2s-4w, dry, TD 8,366 ft., oolitic sandy lime 3,705-10 ft., conglomerate sand 3,805-3,962 ft., Deese 4,317 ft.

LA.-ARK.

DeSoto Parish Wildcat Acidizing to Test

SHREVEPORT.—Two wildcat tests in North Louisiana were attracting interest this week. In DeSoto Parish, Phillips Petroleum Co. 1 Nabors, 28-12n-14w, reported 12 bbl. distillate and some water and was being acidized before further testing.

In Bossier Parish, north of Plain Dealing, Barnsdall Oil Co.'s 1 Carter-Burton unit, 26-23n-13w, was drilling below 11,746 ft. on last report, and was thought to be in the lower Cotton Valley zone.

Three Caddo Parish tests being watched are: Phillips 1 Cush, 19-19n-16w, near Longwood, drilling below 6,286 ft.; same operator's 2 Waskom, 30-19n-16w, drilling at 6,222 ft.; and W. C. Feazel's 1 S. L. Herold, 21-15n-16w, which was drilling below 5,835 ft.

The state conservation department announced six permits in Northern Louisiana last week.

Drilling reports on Arkansas wildcats were, Columbia County: McAlester Fuel Oil Co. 1-B Harris, 10-17s-19w, drilling below 7,000 ft.; Root Petroleum Co.'s 1 Threadgill, 15-17s-19w, drilling at 5,456 ft. Lafayette County: Carter Oil Co. 1 Winham, 3-16s-28w, drilling at 6,600 ft. Miller County: Carter's 1 Offenshauser, 5-17s-26w, installing cable tools preparatory to shooting.

MISSISSIPPI

Heidelberg Field Accounts For Rise in Production

JACKSON.—An increase in the daily average production in Mississippi, mainly from the Heidelberg field in Jasper County, reached more than 67,000 bbl. per day last week and placed the state in tenth position among the nation's oil-producing states. In addition to this over-all rise in production, new locations continue to figure in the drilling activity. Danciger Oil & Refining Co. has staked two new locations in Lincoln County: the 1 V. G. Allen, 5-7n-7e, a north offset to the California Co. 1 Ras Smith, and the 1 Oscar Hall, 34-8n-7e, 2 miles northeast of the Brookhaven field discovery well, the California Co. 1 G. T. Smith. Gwinville field has three new locations: Humble C-1 Denkman, 35-9n-19w, diagonal southeast offset to their B-1 Denkman, Humble 1 S. V. Quin, 19-9n-19w, and Superior Oil Co. 1 Milloy, 17-9n-18w, in the north gas-producing area of the field.

A large number of tests for subsurface data as well as for oil are contemplated for the edges of the Sharkey Platform, and McAlester Fuel Co. 1 Anderson-Tully Lumber Co., 35-18n-1e, in Warren County, is generally considered the first play in Mississippi to be based on geological information and interpretation. The well is currently drilling below 6,565 ft. in anhydrite.

CALENDAR

July

Houston Nomads, Old College Inn, Houston, July 29.

Independent Petroleum Association of America, executive committee and state vice presidents, Plains Hotel, Cheyenne, Wyo., July 30-31.

August

Interstate Oil Compact Commission, quarterly meeting, August 8-10, Grand Rapids, Mich.

Texas Railroad Commission, statewide allowable hearing, Austin, August 16.

Houston Nomads, Old College Inn, Houston, August 12.

American Institute of Chemical Engineers, western convention, Palace Hotel, San Francisco, August 25-28.

September

Houston Nomads, Old College Inn, Houston, September 9.

Sixth annual Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va., September 9-11.

American Chemical Society, semiannual meeting, Chicago, September 9 to 13.

Pacific Coast Gas Association, annual convention, Fairmont Hotel, San Francisco, September 10-12.

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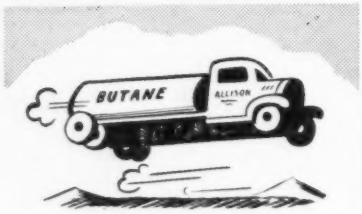

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Tulsa, Okla. . . . 3-6143
Hobbs, N. Mex. . . . 275-R
DAY OR NIGHT

Among the

Drilling Contractors

Union Drilling & Producing Co. is contractor on the Sohio Petroleum Co. 1 Douglas-Wandel Comm., in NW NE NE 10-12n-8w, Montcalm County, Michigan.

Kingery & Patterson hold contract for R. H. Pierce's 3 Orwig, NE SE NE 14-8n-7e, in the Wewoka Lake field of Seminole County, Oklahoma.

Moran Brothers, Wichita Falls, Tex., have contract for Texola Drilling Co. and J. W. Sorrels 1 Levy, a wildcat test three miles east of Archer City, Archer County, Texas. Contract depth is 5,000 ft. On last report operators had run surface pipe.

W. C. Taggart has contracts for two wells in the Goodwell area of Newaygo County, Michigan. Locations are for Michigan Consolidated Gas Co.'s 1 William Winkler et al, in 4-14n-11w, and the same company's 1 Harold Neville et al, in 5-14n-11w.

Rhodes Drilling Co., Abilene, Texas, has contract to drill Warren Petroleum Corp. and F. T. Morrow 2 Mrs. Ruby Russell et al, Section 18, S. Wallick Survey, Menard County, offset to 1 Russell, recent discovery.

Olsen-Blount Drilling Corp., Oklahoma City, have started drilling at Uscan Drilling Co. et al 1 Blankenship, NW SE 18-24s-37e, in the Langlie-Mattix field of Lea County, New Mexico. Other operations in Lea County by Olsen-Blount last week reported: Testing at 6,420 ft. at R. Olsen Oil Co. 2 Boyd; testing and cleaning out after shot at Uscan Drilling Co. 1 Clift, SW SE 8-23s-37e, both in the Penrose-Skelly field.

Gutowsky Brothers Drilling Co.'s 8,000-ft. test for Wilcox Oil Co. et al, south of the town of Ringwood, in Major County, Oklahoma, was drilling below 6,648 ft. after recovering 100 ft. of oil-cut mud with a show of gas in the Mississippian chat at 6,630-46 ft. Contract depth is 8,000 ft. Gutowsky was reported to have an interest in the well.

Delta Drilling Co. will drill a wildcat for L. B. Benton and W. J. Weaver two miles northeast of Alba in Wood County, Texas. The test, contracted to 6,500 ft., is the McKenzie and is located in the J. P. Wood survey. Delta Drilling was reported to have an interest in the venture.

Mealy-Wolfe Drilling Co. will drill Otha H. Grimes 2 Meadors, SW SW SE 24-8n-10e, Hughes County, Oklahoma.

Penrod Drilling Co. holds contract for Placid Oil Co.'s 20-A Tremont Lumber Co. in 24-9n-1e, LaSalle Parish, Louisiana. Location of the 4,000-ft. test is in the Nebo field.

E. L. & M. Drilling Co.'s 1 Bowles, NW NW SE 9-6n-6e, east of the Konawa pool in Seminole County, Oklahoma, was reported drilling below 2,200 ft.

De Soto Drilling Co., Gladewater, Tex., has contract to drill B. F. Phillips 2 C. C. Crews, wildcat in the Leonard Perkins Survey, 7 miles south of Gladewater, Gregg County.

Iron Drilling Co. 1 Hoyt, SE SE SW 24-19-9w, a wildcat in northwestern Rice County, Kansas, is drilling ahead in an attempt to extend production a mile southeast of the Chase pool. Tide Water Associated Oil Co. and Murphy Oil Co. of Pennsylvania are said to be supporting the venture with dry-hole money.

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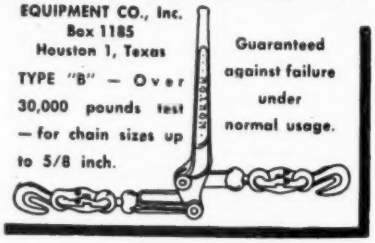

Guaranteed against failure under normal usage.

DeSoto Drilling Co. will drill the 2 C. C. Crews for B. F. Phillips in Gregg County, East Texas, ¼ mile north of the 1 Crews, which was reported to be testing in the Woodbine.

Crown Drilling Co. has staked the fifth test in the West Merten pool area of southwestern Barton County, Kansas. The new well, 2 Weber, NW SE SW 5-19-15w, is an attempt to extend production northward from the field.

Addison Drilling Co., Midland, Tex., has contract to drill Union Oil Co. of California 1-F Mrs. A. C. Means estate, Andrews County wildcat in Section 1, Block A-46, Public School Lands, 2 miles northwest of Andrews.

Andrew H. Hoyt will drill a wildcat test for Shiawassee Deep Drilling Co. at the 1 Herbert G. Haight, SE SE SW 10-5n-3e, Shiawassee County, Michigan.

Stickle Drilling Co., Tulsa, has opened a branch office at Wichita, Kan., with R. B. Parriott as manager. Parriott recently returned after four years' service in the Army.

Addison Drilling Co., Midland, Tex., have contract for Union Oil Co. of California's 1-F Means estate, in Section 1, Block A-46, PSL survey. The wildcat, located two miles northwest of Andrews, in Andrews County, Texas, is contracted to 4,800 ft., or to the San Andres zone.

Sharon Drilling Co. has made location for the 1 Sangster in SE SW NW 14-19s-9w, Rice County, Kansas. Same company's 1 Koenig, SE SE NW 12-20s-10w, was drilling below 2,976 ft. on last report.

Delta Drilling Co. made location for its wildcat, 1 Southern Pine, in Z. Gibbs survey, one mile south of the Rusk field, Cherokee County, East Texas. Delta also was drilling ahead at W. W. Wise's 1 J. O. Huggins, in the Levi Jordan survey of Cherokee County.

Drilling Contractors Make $6,000 University Grant

AUSTIN, Tex.—The University of Texas has received a $6,000 grant from the American Association of Oilwell Drilling Contractors for use in research and training in drilling equipment and methods.

T. H. Shelby, dean of the university's division of extension, James R. D. Eddy, director of the industrial and business extension bureau, and John Woodruff, state coordinator of petroleum industry training, will work with a committee of the association consisting of J. E. Warren, Midland, chairman; Howard Holmes, Dallas; Travis Kerr, Oklahoma City; C. W. Alcorn, Houston; and L. W. Sullivan, Tulsa.

The first phase of the program will embrace study and training in the use and control of drilling fluids. Drilling equipment and drilling practice are scheduled for study later. During the coming year, work will be carried on at Rangely, Colo.; Great Bend, Kans.; Oklahoma City and Tulsa; Hobbs, N. M.; Shreveport, La.; and Kilgore, Beaumont, Houston, and Corpus Christi, Tex. The work will be developed in cooperation with state and local industrial education authorities.

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Change in size of tong jaws can be made quickly and easily. The dies are self sharpening and provide a quick, positive, non-crushing grip. The handle is made of reinforced seamless tubing, and is designed to provide sturdy, balanced construction. Stabbed on, these tongs cannot come open even if hinge pin fails, yet jaws easily release by pulling back on the sleeve. Call your BJ supplier and let him equip your rigs with "T" tongs.

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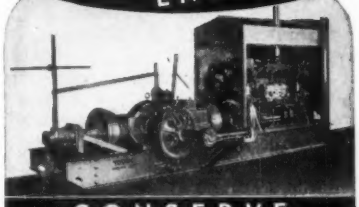

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PERSONALS

Montgomery Joined Stanolind in 1919 As Chemist

THE career of S. A. Montgomery has been characterized by a steady climb up the executive ladder in the manufacturing organization of Stanolind Oil Co. (Indiana.)

Montgomery's latest promotion early this year made him assistant manager of manufacturing in the company's Chicago general office. For the previous 3½ years, he had been manager of the Whiting, Ind., refinery.

Montgomery was graduated from Mississippi A. & M. College in 1917. During the next 2 years, he was in government employ in Washington, D. C.; Muscle Shoals, Ala., and Arlington, Va. He joined the Indiana Standard in 1919 as a chemist in the research department at the Wood River, Ill., refinery in 1919.

In the next 10 years, he served successively as assistant superintendent of the refinery's paraffin department, superintendent of the lubricating and paraffin department, assistant general superintendent, general superintendent, and manager. He was transferred to Whiting as manager in 1942, serving there until he was moved to Chicago.

Edward C. Sommer, Jr., has been named assistant safety supervisor at Standard Oil Co. of New Jersey's Baltimore refinery. **Franklin H. Cummings** has been transferred from Standard Oil Development Co.'s Esso engineering department to succeed Sommer as safety engineer, and will assist **R. W. Black,** chief safety engineer for Jersey Standard.

Roy A. Wilson, geologist for Gulf Oil Corp., is visiting in Colombia.

Val B. Kielland, chief engineer for The Texas Co. in Colombia, recently left with his family for a vacation in Norway.

E. N. Foster, assistant district purchasing agent of Gulf Oil Corp. in Fort Worth, has been made assistant division purchasing agent and transferred to Houston.

Arthur G. Baalim, oil operator of Lethbridge and director of the Canadian Western Natural Gas, Light, Heat & Power Co., was included in the Dominion Day King's honor list. He was awarded the Order of the British Empire.

R. W. GEMMER

H. W. BROWN

George E. Wagoner, assistant chief geophysicist in charge of domestic geophysical operations for Carter Oil Co., has been appointed exploration manager for the Carter's southern division with headquarters in Shreveport. Three other changes announced by **H. F. Moses,** vice president in charge of exploration, also become effective August 1. **R. W. Gemmer,** now assistant chief geophysicist in charge of foreign geophysical operations, will take charge of both foreign and domestic geophysical operations. **H. W. Brown** will continue as Gemmer's assistant and will have charge of foreign geophysical work. **P. L. Lyons,** office computer, will become technical supervisor with general supervision of computing and interpretations of geophysical work in the field and division offices.

G. E. WAGONER

W. S. Olson, chief geologist for The Texas Co. with headquarters in New York, is currently visiting in Bogota.

George Johnston, marine manager for Creole Petroleum Corp., has been in the United States for the last several weeks on a business trip. He is returning to his Caracas headquarters.

Arthur Malackey, senior petroleum engineer for Carter Oil Co., has rejoined the company's eastern division after 3 years of Army service. He held the rank of major at the time of release. Other Carter returnees are **E. Richard Sims,** junior geophysicist with the eastern division, who spent nearly 4 years in the Pacific theater with the Army Signal Corps. Sims went into the Army while stationed in Sumatra for Carter; released a lieutenant colonel. **Thomas H. Philpott** returned to Shreveport, La., as a paleontologist after service in the Navy. **Emmet C. Wells, Jr.,** senior petroleum engineer at Mattoon, Ill., who commanded the Second Battalion of the 389th Infantry in the Pacific Theater, released a lieutenant colonel. **Amil B. Cockrum,** geologist at Oklahoma City, who served with the Air Corps in India for 2 years. **Robert L. Poundstone,** junior petroleum engineer at Shreveport, La., who served in the China - Burma - India Theater with the Navy. **John L. Edwards,** geologist in the exploration department, who was a B-24 navigator in the Pacific; **Beverly B. Bradish,** senior geologist at Lander, Wyo., who was a gunnery officer with the Navy. Bradish was released a lieutenant after serving in both the European and Pacific theaters.

C. C. CAMPBELL

Colin C. Campbell, Tulsa, has been appointed business manager of the Society of Exploration Geophysicists. It was also announced that the business manager's office is being transferred from Hamilton, Tex., to Tulsa, with headquarters to be established in the Ritz Building. **G. E. Wagoner,** geophysicist with Carter Oil Co., is secretary-treasurer of the organization.

Robert B. Curran and **Paul C. Shea,** Carter Oil Co. officials of Billings, Mont., have been elected vice presi-

R. B. CURRAN

PAUL C. SHEA

dents of the company, **O. C. Schorp,** president, announced this week, following a meeting of the board of directors. Shea, who will be vice president in charge of manufacturing and will direct all refining operations, will transfer his headquarters to Tulsa. Curran will continue as northwest division manager and will remain at Billings.

C. D. Edmondson, formerly with The Texas Co., has become an independent operator at Casper, Wyo.

Arthur Peterson, for the past several years a member of the geological staff of Mohawk Oil Co., has entered private practice as consulting geologist and petroleum engineer.

R. B. Phillips, geologist, has joined **S. D. Johnson** at Wichita Falls, Tex., with the closing of Midland Oil Corp.'s office there. **John M. Mouser,** land man, is remaining as an independent operator.

Clarence T. Smith, Flora, Ill., attorney and independent operator, has assumed his duties as Illinois representative on the Interstate Oil Compact Commission. He was appointed by **Gov. Dwight H. Green.** Smith was Illinois representative on the Compact Commission in 1941-43, resigning because of ill health and personal business. He is a director and general counsel of the Illinois Oil and Gas Association and was formerly Illinois director of the Independent Petroleum Association of America.

Dr. William J. Sparks, since 1941 associate director of the chemical division of Standard Oil Development Co., Elizabeth, N. J., has been elected chairman of the American Chemical Society's North Jersey Section. He succeeds **Robert Waterman** of the Schering Corp., Bloomfield. Other new officers of the section include **Theodore R. Donlan** of Standard Oil Co. (N. J.), secretary.

DR. W. J. SPARKS

Gene Abernathy, petroleum engineer with Phillips Petroleum Co., has been transferred from Odessa, Tex., to Eureka, Kans.

H. H. Plummer, chief petroleum engineer of the Mene Grande Oil Co., C. A., has resigned his position, effective August 1, and will return to the United States. His home is in Buffalo, Mo. Plummer was connected with Mene Grande's operations in Venezuela for 12 years.

Dr. Gustav Egloff of Universal Oil Products Co., next month will deliver a series of lectures before various local chapters of the Institute of Petroleum of Great Britain in England, Scotland, and Wales. He will also lecture at Oxford and Cambridge universities and will address the Catalyst Club of England, in London. His subjects are "Catalysis in the Oil Industry," "Petroleum as a Chemical Industry," and "Modern Products from Crude Oil." He will leave Chicago on August 5 by air for London. August 20 he will fly from London to Gothenburg, Sweden, to join a party of American scientists and technologists who will visit the universities and the centers of scientific and industrial research of the Scandinavian countries at the invitation of the Royal Swedish Academy of Engineering Research.

H. M. Morse, supervisor of the Mississippi State Oil and Gas Board, has been elected department commander of the Mississippi American Legion. A graduate of Oklahoma University, Morse has been supervisor since 1938. Previously he was assistant state geologist at the University of Mississippi and served in the Navy during World War 1.

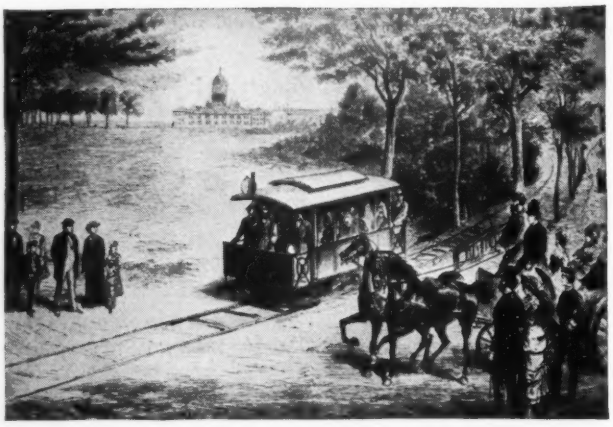
Charles T. McCord, Jr., Shreveport, La., has been named president of the newly organized Ark-La-Tex Landmens' Association, composed of oil and gas company employes in the tristate area. Members elected to other positions are: **Charles W. Day, Jr.,** vice president; **Jack Hamilton,** secretary-treasurer; and **Lon Mason, T. C. Patterson, L. S. McGee, F. H. Harrell,** and **J. W. Koonce,** executive committee members.

N. F. Anderson, foreman in the producing department of The Texas Co. at Odessa, Tex., has received the President's Medal of the National Safety Council. He is credited with saving the life of **Virgil Robert Green, Jr.,** Superior Paraffin Co. employe, after he had been overcome by fumes from a storage tank last March 8 near Odessa. Anderson applied artificial respiration. **C. B. Williams,** West Texas Texaco division manager, awarded the medal to Anderson last week at Midland.

John R. Suman, vice president, Standard Oil Co. of New Jersey, and **Charles V. Millikan,** chief production engineer, Amerada Petroleum Corp., have been nominated for 3-year terms as members of the board of directors of the American Institute of Mining and Metallurgical Engineers. **Howard C. Pyle,** vice president, Bank of America, Los Angeles, and formerly chief production engineer, Union Oil Co. of California, was nominated as chairman for 1947 of the institute's petroleum division. **John H. Murrell,** general manager, DeGolyer & McNaughton, and **Lloyd Elkins,** Stanolind Oil & Gas Co., were nominated as regional chairmen of the petroleum division. Proposed for membership on the executive committee of the petroleum division were: **John E. Sherborne,** Union Oil Co. of California; **Stuart E. Buckley,** Humble Oil & Refining Co.; **William W. Porter, II,** consulting engineer, Los Angeles; **William V. Vietti,** chief petroleum engineer, The Texas Co., Houston; **Dr. Joseph B. Umpleby,** petroleum engineer, Dallas, and **William B. Berwald,** petroleum engineer, Ohio Oil Co.

Shifts—

A. D. Henderson, Jr., superintendent, Standard Oil Co. of California, Avenal, Calif., to Taft, Calif.; **T. E. Beaird, Jr.,** engineer, Humble Oil & Refining Co., Palestine, Tex., to Hawkins, Tex.; **R. D. Wroten,** engineer, Union Producing Co., Robstown, Tex., to Pettus, Tex.; **R. H. Burton,** foreman, Amerada Petroleum Corp., Seagraves, Tex., to Big Lake, Tex.; **C. E. Rawlins,** engineer, Phillips Petroleum Co., Borger, Tex., to Phillips, Tex.; **R. W. McIlvain, Jr.,** manager, Pure Oil Co., Fort Worth, Tex., to Billings, Mont.; **E. H. Blackaller,** engineer, Stanolind Oil & Gas Co., Fort Worth, Tex., to Pampa, Tex.; **H. R. Webb,** engineer, Sun Oil Co., Kilgore, Tex., to Tyler, Tex.; **R. N. Bills,** geologist, Amerada Petroleum Corp., Alexandria, La., to Vicksburg, Miss.; **James T. Grady, Jr.,** engineer, The Texas Co., McLeansboro, Ill., to Wichita, Kans.; **C. E. Deaton,** geologist, Centralia, Ill., to Albany, Ky.; **M. A. Tibbetts,** geologist, McComb, Miss., to Tulsa; **Paul W. Laughrey,** engineer, Socony-Vacuum Oil Co., Inc., Webster Grove, Mo., to Louisiana, Mo.; **R. G. Rhodes,** engineer, Shell Oil Co., Inc., St. Louis, Mo., to Wood River, Ill.; **Everett S. Sherwood,** foreman, Pure Oil Co., Weidman, Mich., to Temple, Mich.; **C. O. Van Ness,** engineer, Stanolind Pipe Line Co., Lloyd, Colo., to Topeka, Kans.; **C. L. Kelso,** foreman, Whitaker Construction Co., Oilton, Okla., to Ebensburg, Pa.



Famous Facts

The first electric street railway line was installed at Lichterfelde, Germany, by Werner Siemens and opened for traffic in May, 1881. One motor car was used with both rails conducting the current at low potential.

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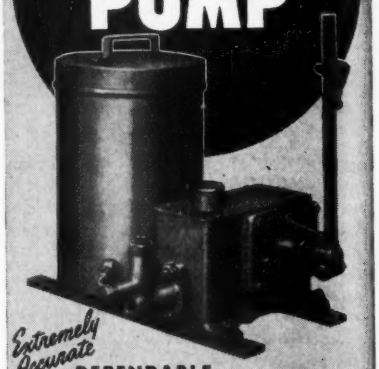

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Equipment Men in the News

Hale Heads New Sales Office for Bovaird

Hugh Hale, well known to the oil industry in Texas, has been selected to manage the new sales office of Bovaird Supply Co. which was recently opened in the Continental Building in Dallas.

Hale's first position in the petroleum world was with Oil Well Supply in Tulsa in 1917. He joined Atlas Supply Co. in 1936 to work in Dallas where he had resided since 1932.

Duncan Returns From South America

Dan Duncan, field engineer of Emsco Derrick & Equipment Co., has just returned from an extensive trip to Venezuela where he assisted in the setting up of two Emsco Type J-750 drilling rigs for Socony-Vacuum in the Guico area. He also spent considerable time in Maracaibo, checking on the operation of power rigs and other miscellaneous equipment with Richmond Exploration Co., Drilling & Exploration Co., V.O.C., etc.

Trotman Heads New Bowser Division

J. B. Trotman, Grand Rapids, has been appointed head of the new Bowser, Inc., industrial pump division. Trotman has been identified with the pump industry for 30 years and has been for the past 6 years general sales manager of Blackmer Pump Co., Grand Rapid. Headquarters of the new Bowser division will be in Fort Wayne.

Crutcher, of C-R-C, Injured in Accident

A. S. Crutcher, of Crutcher-Rolfs-Cummings, Houston, was injured in an automobile accident July 12. He is confined to the Hermman Hospital, Houston.

New Friden Distributors Are Appointed

S. M. FRIDEN

Appointment of 12 new distributors of Friden calculators in foreign markets is announced by Stanley M. Friden, export sales manager, Friden Calculating Machine Co., Inc., San Leandro, Calif.

The appointments, which cover scattered markets, reflect the renewal of selling activity in Europe with the appointment of General Import Co., Rue d'Arenberg 14, Belgium; Pindborg & Petersen, Larsbjrnsstraede 23, Copenhagen K, Denmark; O.Y. Merso A.B., P. Esplanaadikatu 33, Helsinki, Finland, and Casar Muggli, Lintheschergasse 15, Zurich, Switzerland.

Other appointments include Henk van der Voet, Kerkplein 1, P.O. Box 129, Paramaribo, Surinam; A. Leonard Moses, 92 Harbour Street, Kingston, Jamaica, B.W.I.; Organizacion Tecnica (Carlos C. Stani), Chile 394, Asuncion, Paraguay; D. Spanos, Sucrs. Ltda., Ruas Consiglieri Pedroso 82 e, Dr. Salazar 29, Caixa Postal 434, Lourenco Marques, Portuguese East Africa; Lines Bros., First Street, P.O. Box 1377, Salisbury, Southern Rhodesia; Granby Stores, Ltd. (subagent for Pereira & Co., Trinidad), St. George's, Granada, B.W.I.; Serafin Ferrufino, S.A., Casilla 197, La Paz, Bolivia; and for Korea & Manchukuo, Peter Gold, c/o Howard Novelty Co., 251 Post Street, San Francisco.

Ward Goes to Dallas for Templeton, Kenly & Co.

Appointment of Robert A. Ward as sales engineer for Templeton, Kenly & Co. in the southwestern territory, has been announced. Ward started with the company in manufacturing and production cost work and has, since his recent return from military service, been active as assistant to the secretary-treasurer of the company.

Linde Air Products to Expand Amarillo Plant

Expansion of its facilities at Amarillo to include an acetylene producing plant has been announced by The Linde Air Products Co., a unit of Union Carbide & Carbon Corp. The site will include a warehouse for distribution of Union carbide and Carbic processed carbide.

Daniels Named Vice President Of Hydril Co.

Earle M. Daniels, sales manager of Hydril Co. for the past 10 years, has been named vice president of the company. Daniels will divide his time between the Houston and Los Angeles offices.

Midland Supply Co., Inc., Formed

E. Max Beren, formerly vice president and general manager of Mountain Iron & Supply Co., Wichita, has disposed of his interest in that company and formed Midland Supply Co., Inc., which he will head as president. Offices are in the Globe Building, Wichita. First store has been established at Russell, where the firm will supply products of Republic Steel Corp., Pittsburgh Steel Co., S. M. Jones Co., Walworth Co., and others to form a complete line of general oil-well supplies. Homer J. Henderson is associated with Beren as executive assistant, and L. M. Barnes is in charge of warehouses and field activities.

Baird District Sales Supervisor For Barrett Division

Hugh W. Baird, who for many years has been identified with National Tube Co., has accepted the position of district sales supervisor for the Barrett Division, Allied Chemical & Dye Corp., with headquarters in Chicago.

New Officers for Security Engineering Co.

O. HAMMER

A change of officers has been announced by Security Engineering Co., Inc., Whittier, Calif., one of the Dresser Industries. W. E. Sievers, former president, has been elected chairman of the board, and O. Hammer has been elected president and general manager. Hammer has been associated with Security since its inception in 1931. Production facilities of Security Engineering are being expanded including the installation of special high-speed machinery and a new electrical heat-treating plant.

R. M. (Bob) Cook, vice president and general sales manager, is conducting a sales and service expansion program for security products throughout the United States. New warehouses and offices are being constructed in Oklahoma City and Odessa, Tex.

Nichols Heads Geolograph Co.

P. B. Nichols, of Oklahoma City, has resigned his position as district geologist for Cities Service Oil Co. to be president of the Geolograph Co., with offices at 25 North Western, Oklahoma City. Nichols is the inventor of the Geolograph mechanical well-logging instrument.

Hardy Made Chief Engineer For W. C. Norris

A. A. HARDY

W. C. Norris, Manufacturer, Inc., Tulsa, announces the appointment of A. A. Hardy as chief engineer. Hardy replaces J. Scott Thompson, who recently resigned. The new chief engineer was formerly associated with American Mfg. Co.

Weingartner to Head Production Control

J. W. Weingartner has been made production control manager of Brown Instrument Co., Philadelphia, it is announced by Marshall B. Taft, assistant to the president. Weingartner has been with this industrial

division of Minneapolis-Honeywell Regulator Co. for the past 22 years. He will also direct purchasing.

Charles Goodman has taken over the duties of purchasing agent under Weingartner's supervision and William Lawson has been named assistant production control manager.

Clark Brothers Co. Announces Personnel Changes

G. R. MADDOX

G. R. Maddox will take charge of Clark Brothers Co.'s branch office soon to be opened in Caracas, Venezuela. Prior to the war, Maddox spent 8 years in Venezuela in the production and engineering department of Standard Oil Co. In addition to Clark Brothers, he will represent certain others of the Dresser industries. T. R. Foster has joined Clark Brothers Co., Inc., at Olean, N. Y., where he will head up Clark's centrifugal compressor sales department. Previous to joining Clark's he was associated with the Carrier Corp. for 17 years, Joe Y. Allen, Jr., has joined Clark Brothers Co., Inc., as engineer in the technical service department of Clark's Houston office.

T. R. FOSTER

J. Y. ALLEN

British Monarch Honors SKF Chief

William L. Batt, president of SKF Industries, Inc., of Philadelphia, has been made an honorary companion of the Order of St. Michael and St. George by King George VI in recognition for his wartime work as a member of the Combined Production and Resources Board, composed of representatives of the U. S., Canada and Great Britain.

Herbert Joins Hewitt Rubber

Howard D. Herbert has joined the Restfoam sales department of Hewitt Rubber at the Buffalo headquarters.

Herbert served the Goodyear Tire & Rubber Co. for 15 years and has been manager of Airfoam sales since 1940.

Restfoam, the trade name used by Hewitt for its new foam rubber product, is already in production at the Buffalo plant.

Offices Are Moved

Construction Machinery Co., L. C. Bendit, announces the removal of offices to Suite 201 Jameson Building, 1903 Blodgett St., Houston.

New Officers Elected for U. S. Steel Supply Co.

WORTHINGTON

Leadership in the United States Steel Supply Co., a U. S. Steel subsidiary, changed July 15 when Leslie B. Worthington, formerly sales vice president, was elected president, and Ernest E. Aldous retired from the presidency in accordance with the corporation's retirement policy. The company, which maintains general headquarters in Chicago, operates warehouses in Baltimore, Boston, Cleveland, Newark, Pittsburgh, St. Louis and St. Paul as well as in Chicago.

Nettleton Joins Gravity Meter Exploration Co.

DR. NETTLETON

Dr. L. L. Nettleton, former head of gravity interpretation for Gulf Research & Development Co., Pittsburgh, has been named a firm member of Gravity Meter Exploration Co., Houston, W. G. Saville has announced. He will be in charge of interpretation of gravity data and report compilation.

C-R-C Opens Tulsa Sales, Service Branch

GROVER SWARTZ

With the opening recently of a sales and service branch in Tulsa, Crutcher-Rolfs - Cummings, pipe-line equipment manufacturers and suppliers, has nearly doubled its facilities to the Mid-Continent area. Shop facilities in the Houston plant also have been expanded in the last 6 months. Grover Swartz, W. H. "Bo" Bardsley and J. S. Roberts will work out of the new branch.

Swartz will be in charge of ditching machines, shovels, and sales and service. Bardsley will be in charge of general pipeline equipment, while Roberts will be the field service man. The company has purchased a building at 220 West Archer for the new branch office.

Zander in Australia

W. E. Zander, director and vice president of foreign operations for Rheem Manufacturing Co., left July 8 from Los Angeles by plane for a tour of the company's Australian plants. He will visit company operations at Sydney, Melbourne, and Brisbane.

Martin-Decker Men Cover Rocky Mountains and Mid-Continent

E. L. Decker, president, and "Mutt" Donovan, sales and service representative of Martin-Decker Corp., recently made an extended trip. Field problems were studied in Colorado, Wyoming, Kansas, Oklahoma, and Texas.

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